

**PETITION TO THE INTER-AMERICAN COMMISSION ON HUMAN RIGHTS
SEEKING RELIEF FROM VIOLATIONS OF THE RIGHTS OF THE MEMBERS OF
THE SOUTHEAST ALASKA INDIGENOUS TRANSBOUNDARY COMMISSION
RESULTING FROM HARD-ROCK MINING IN BRITISH COLUMBIA, CANADA**

**PETITION TO THE INTER-AMERICAN COMMISSION ON HUMAN RIGHTS
SEEKING RELIEF FROM VIOLATIONS OF THE RIGHTS OF THE MEMBERS OF
THE SOUTHEAST ALASKA INDIGENOUS TRANSCONFINERARY COMMISSION
RESULTING FROM HARD-ROCK MINING IN BRITISH COLUMBIA, CANADA**

SUBMITTED BY THE SOUTHEAST ALASKA INDIGENOUS TRANSCONFINERARY COMMISSION
ON BEHALF OF ITS CONSTITUENT TRIBAL GOVERNMENTS AND THEIR TRIBAL MEMBERS

Petitioners' Legal Representatives:



Ramin Pejan
Martin Wagner
Earthjustice
50 California St., Suite 500
San Francisco, CA 94111
Phone: +1.415.217.2000
Email: rpejan@earthjustice.org
mwanger@earthjustice.org



Eric Jorgensen
Earthjustice
325 Fourth Street
Juneau, AK 99801
Phone: +1.907.586.2751
Email: ejorgensen@earthjustice.org

5 December 2018

CONTENTS

I.	SUMMARY OF THE PETITION	1
II.	JURISDICTION OF THE COMMISSION	4
III.	PETITIONERS WHOSE RIGHTS HAVE BEEN VIOLATED.....	4
IV.	HARD-ROCK MINING IN THE TRANSBOUNDARY WATERSHEDS OF THE TAKU, STIKINE, AND UNUK RIVERS THREATENS NATIVE COMMUNITIES LIVING IN SOUTHEAST ALASKA.....	5
A.	CULTURE AND SUBSISTENCE PRACTICES RELATED TO FISHING IN SOUTHEAST ALASKA NATIVE COMMUNITIES LIVING NEAR THE CANADA-U.S. TRANSBOUNDARY WATERSHEDS.....	6
1.	The Taku, Stikine, and Unuk River Watersheds.....	6
2.	The importance of subsistence fishing for sustaining Petitioners' livelihoods.....	8
3.	Cultural and spiritual practices associated with subsistence fishing	10
B.	THE SIX B.C. MINES THREATEN THE FISH STOCKS THAT ARE CENTRAL TO PETITIONERS' CULTURE, SPIRITUALITY, AND MEANS OF SUBSISTENCE	13
1.	Hard-rock mining pollutes the environment through chronic heavy metals pollution and the catastrophic failure of mine waste containment systems	14
2.	The inadequate regulation and enforcement of mining in British Columbia.....	18
3.	The B.C. Mines threaten the Taku, Stikine, and Unuk watersheds	20
4.	Harm to salmon and eulachon from mining pollution	26
5.	The B.C. Mines pose imminent, ongoing, and significant threats to Petitioners' rights	33
V.	VIOLATIONS: CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' HUMAN RIGHTS	34

A.	THE AMERICAN DECLARATION SHOULD BE INTERPRETED AND APPLIED IN THE CONTEXT OF RELEVANT INTERNATIONAL NORMS AND PRINCIPLES.....	34
1.	The American Convention on Human Rights bears on interpretation of the American Declaration	35
2.	Developments in other international human rights systems and international environmental law should be taken into account when interpreting and applying the American Declaration.....	35
B.	HUMAN RIGHTS OBLIGATIONS RELATED TO THE ENVIRONMENT	36
1.	The American Declaration and the American Convention require states to guarantee that environmental harm does not violate human rights.....	36
2.	States are responsible for acts and omissions within their territories that cause environmental-related human rights violations outside their territories.....	38
3.	The human rights that are implicated by the environmental harm from the B.C. Mines are linked and interdependent	40
4.	Petitioners' claims should be interpreted in the context of the unique relationship between indigenous peoples and their land and environment	40
C.	CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' HUMAN RIGHTS	41
1.	Canada's and British Columbia's approvals of the B.C. Mines violate Petitioners' right to enjoy the benefits of their own culture	42
2.	Canada's and British Columbia's approvals of the B.C. mines violate Petitioners' right to their own means of subsistence as a component of their rights to culture, life, health, and property	46
3.	Canada's and British Columbia's approvals of the B.C. mines violate Petitioners' right to the preservation of health.....	48
4.	Canada's and British Columbia's approvals of the B.C. mines violate Petitioners' right to use and enjoy the lands they have traditionally used and occupied	50
5.	Canada has not consulted with or obtained the free, prior, and informed consent of Petitioners with respect to the B.C. Mines	53

VI.	EXHAUSTION OF DOMESTIC REMEDIES	54
A.	PETITIONERS' EFFORTS TO VOICE THEIR CONCERNS REGARDING THE B.C. MINES	54
B.	PURSUING REMEDIES AT THE DOMESTIC LEVEL WOULD IMPOSE AN UNDUE FINANCIAL BURDEN ON PETITIONERS	55
C.	CANADIAN LAW DOES NOT PROVIDE ADEQUATE OR EFFECTIVE REDRESS FOR PETITIONERS' CLAIMS	56
1.	Canada's environmental assessment laws do not adequately or effectively protect Petitioners' rights.....	56
2.	Canada's indigenous laws do not adequately or effectively protect Petitioners' rights.....	58
3.	Canada's constitutional law does not adequately or effectively protect Petitioners' rights.....	60
VII.	TIMELINESS	62
VIII.	ABSENCE OF PARALLEL INTERNATIONAL PROCEEDINGS	62
IX.	REQUEST FOR RELIEF	63

I. SUMMARY OF THE PETITION

Introduction

1. Southeast Alaska Native communities have depended for millennia upon the pristine transboundary watersheds of the Taku, Stikine, and Unuk rivers. These rivers flow through varied and wild landscapes from British Columbia through Alaska to the Pacific Ocean. These watersheds are teeming with biodiversity, including dozens of species of fish, many of which – particularly salmon and eulachon – have been historical staple commodities for Native communities, and remain centerpieces of their cultural practices and spiritual beliefs.
2. Two hard-rock mining projects are operating and four others are proposed in the upper reaches of these watersheds in British Columbia, Canada, near the border with Alaska and upstream of where Southeast Alaska Native communities harvest fish. These mines (collectively the B.C. Mines) are large-scale industrial projects that are generating and will continue to generate huge quantities of acid-producing and toxic waste products. They pose an imminent threat of polluting downstream waters with highly toxic heavy metals that could cause sustained and significant population declines of the fish that Petitioners rely upon for their subsistence and that are central to the maintenance of their culture.
3. In this petition, the Southeast Alaska Indigenous Transboundary Commission, on behalf of itself and its constituent tribes (Petitioners), respectfully requests the assistance of the Inter-American Commission on Human Rights to obtain relief from the violations resulting from the acts and omissions of Canada in approving and failing to effectively regulate and prevent the threats from the B.C. Mines.

Petitioners

4. The Southeast Alaska Indigenous Transboundary Commission is a consortium of fifteen sovereign tribal nations in Southeast Alaska that live close to the Canadian border. The consortium consists of Chilkat Indian Village of Klukwan, Douglas Indian Association, Organized Village of Saxman, Craig Tribal Association, Ketchikan Indian Community, Organized Village of Kake, Metlakatla Indian Community, Wrangell Cooperative Association, Sitka Tribe of Alaska, the Klawock Cooperative Association, Petersburg Indian Association, Organized Village of Kasaan, Hydaburg Cooperative Association, Yakutat Tlingit Tribe, and Central Council of Tlingit and Haida Indian Tribes of Alaska.



View of the Tulsequah River, looking east towards the confluence with Taku River. *Photo by Chris Miller - csmphotos.com*

5. These tribes' traditions, beliefs, food sources, and livelihoods are inextricably tied to the fish they catch in the Taku, Stikine, and Unuk watersheds, which are sacred to the communities that have depended on them for millennia. Subsistence fishing is a vital aspect of the tribes' cultural practice and provides a key opportunity for elders to pass on their tribes' traditions to younger generations. Sharing fish catches with elders and others from within and outside of the community is also important for maintaining and strengthening tribal and communal culture and relationships. Harvests of salmon and eulachon sustain Southeast Alaska Native communities throughout the year and are a critical source of food and economic livelihood.

Pollution from the B.C. Mines Is an Imminent and Significant Threat to the Human Rights of Southeast Alaskan Native Communities

6. The B.C. Mines will generate large amounts of waste that can cause acid mine drainage, a toxic cocktail of acidic water and dissolved heavy metals. Although mine operators attempt to contain and treat acidic byproducts, treatment often does not perform as planned. The result is that acid mine drainage pollution is a common occurrence, including in British Columbia.
7. Most of the B.C. Mines also use a highly risky method of storing toxic byproducts or tailings in wet dam enclosures that have a history of failure. When these dams fail, they release huge amounts of toxic sludge into surrounding rivers and streams, catastrophically polluting downstream waters.
8. Compounding these threats, British Columbia has a history of poor enforcement and regulation of mines that has led to long-term and ongoing acid mine drainage from old mining sites and several catastrophic tailings dam breaches. In fact, Canada has the second-worst mining tailings spill record in the world over the past decade. The August 2014 tailings dam failure in Mount Polley, British Columbia, was one of the most harmful, releasing millions of cubic meters of toxic waste into nearby lakes and rivers. Canada and British Columbia cannot be counted on to prevent significant harm from the B.C. Mines to indigenous communities living downstream.
9. Pollution from the B.C. Mines could cause sustained and significant reductions in salmon or eulachon populations in the Taku, Stikine, and Unuk River watersheds. Such impacts would significantly harm Petitioners' generations-old subsistence practices that form a mainstay of their livelihood, culture and traditions. In that event, Petitioners would not be able to share their culture and traditions with future generations, including through teaching younger generations in subsistence practices, the culture of gift giving, and the ceremonial use of traditional foods. They would no longer be able to rely on fish from these watersheds for their subsistence and livelihoods. Their rights to enjoy the benefits of their culture, an adequate means of subsistence, health, and to use and enjoy the lands they have traditionally occupied would be violated.

Canada Has an International Human Rights Obligation to Take Steps to Prevent Transboundary Harm from the B.C. Mines

10. Canada has a duty to prevent the B.C. Mines from degrading transboundary watersheds to an extent that infringes upon Petitioners' human right to enjoy the benefits of their culture, means of subsistence and other rights. Through its approval of the mines and its failure to adequately regulate and prevent the threats they pose, Canada has failed to take necessary and precautionary measures to guarantee Petitioners' rights. Canada cannot shield itself from legal responsibility in this case just because Petitioners live outside its territory.
11. Moreover, neither Canada nor British Columbia has consulted with or sought the free, prior, and informed consent of Petitioners during the approval or permitting of any of the B.C. Mines. The governments have not conducted or required any assessment of the mines' transboundary impacts in the watersheds, thus limiting Petitioners' ability to understand the potential threats to their rights to culture and adequate means of subsistence. Likewise, they have not sought any information from Petitioners concerning how pollution from any of the operating and/or proposed mines might harm Petitioners' human rights. Without taking these steps, Canada and British Columbia are violating Petitioners' rights to be consulted, to free, prior, and informed consent, and to participate in decisions regarding any measure that affects their territory. These rights are critical to the protection of Petitioners' human rights because of the intrinsic relationship between Petitioners' territory and their culture, livelihoods, and well-being.

Request for Relief

12. Because this petition raises violations of the American Declaration of the Rights and Duties of Man by Canada, the Commission has jurisdiction to receive and consider it. The petition is timely because the acts and omissions of Canada that form the basis for the petition are ongoing, and the human rights violations they are causing are continuing. Moreover, there are no domestic remedies suitable to address the violations.
13. In light of the violations described above, Petitioners respectfully request that the Commission:
 - 1) Make an onsite visit to investigate and confirm the threats to the Southeast Alaskan Native communities from the B.C. Mines;
 - 2) Hold a hearing to investigate the claims raised in this petition;
 - 3) Prepare a report setting forth all the facts and applicable law, declaring that Canada's failure to implement adequate measures to prevent the harms to Petitioners from the B.C. Mines violates rights affirmed in the American Declaration of the Rights and Duties of Man, and recommending that Canada:
 - a. Suspend approval and/or operations of the B.C. Mines until it has thoroughly assessed and addressed the risk to Petitioners' human rights;

- b. Consult with Petitioners and seek their free, prior, and informed consent with respect to each of the B.C. Mines as required by international law;
- c. Establish and implement, in coordination with Petitioners, a plan to protect them and the resources they depend on from the disastrous effects of pollution from the B.C. Mines, including the watersheds and fish species used by the Southeast Alaskan Native communities whose rights have been violated; and
- d. Provide any other relief that the Commission considers appropriate and just.

II. JURISDICTION OF THE COMMISSION

14. The Commission has competence to receive and act on this petition in accordance with articles 1.2.b, 18, 20.b, and 24 of the Commission's Statute.

III. PETITIONERS WHOSE RIGHTS HAVE BEEN VIOLATED

15. This petition is submitted by the Southeast Alaska Indigenous Transboundary Commission (SEITC) on behalf of its member tribal nations.

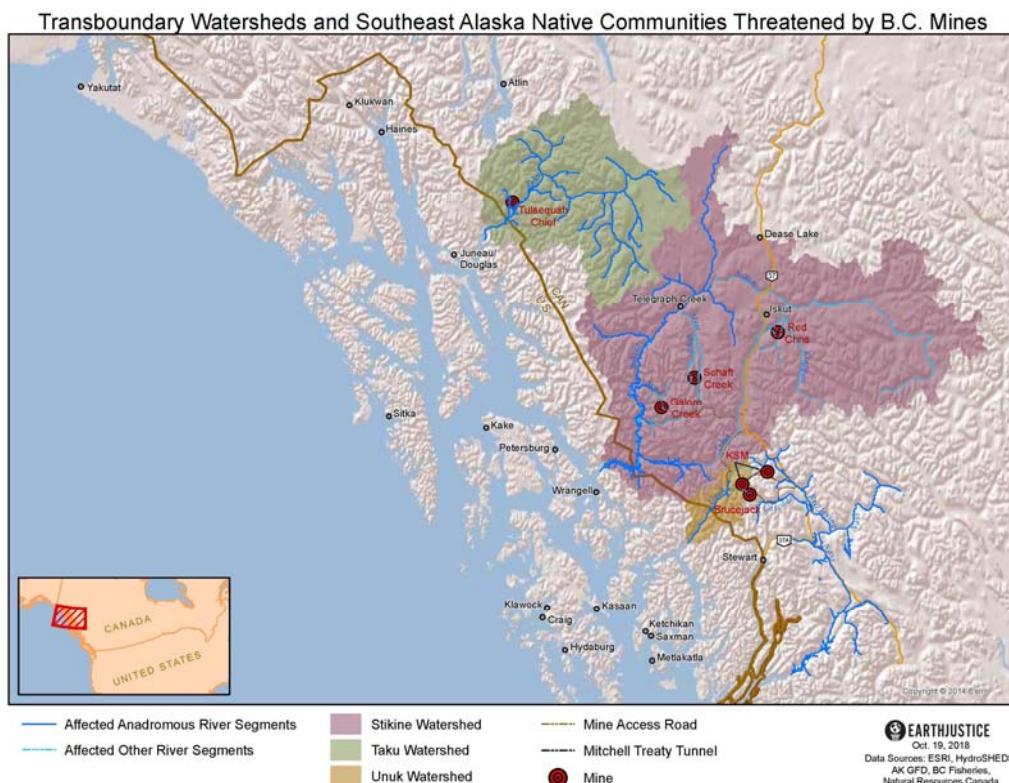
Southeast Alaska Indigenous Transboundary Commission

P.O. Box 695, Wrangell, AK 99929, United States, Phone: (907) 305-0120

16. SEITC is a consortium of fifteen sovereign tribal nations located in Southeast Alaska. It was established in March 2014 as the United Tribal Transboundary Mining Work Group, in order to protect the vital and sacred rivers that sustain its member tribes' communities and culture. Its members are Chilkat Indian Village of Klukwan, Douglas Indian Association, Organized Village of Saxman, Craig Tribal Association, Ketchikan Indian Community, Organized Village of Kake, Metlakatla Indian Community, Wrangell Cooperative Association, Sitka Tribe of Alaska, Klawock Cooperative Association, Petersburg Indian Association, Organized Village of Kasaan, Hydaburg Cooperative Association, Yakutat Tlingit Tribe, and Central Council of Tlingit and Haida Indian Tribes of Alaska.¹
17. SEITC derives its authority from its member tribal governments. Each member tribe has formally designated its representative by letter or resolution. The organization is run by administrator Tis Peterman and a four-member board, with Rob Sanderson Jr. as Chairman, Jennifer Hanlon as Vice Chair, John Morris, Sr., as Secretary, and Lavina (Lovey) Brock as Treasurer.
18. In submitting this petition, SEITC represents the interests of its member tribal nations whose rights to culture, physical health and well-being, means of subsistence, and property are being violated by Canada's acts and omissions. Although SEITC member tribes' cultures and ways of life are a collective and shared interest, certain tribal nations are particularly harmed by the acts and omissions of Canada that are the subject of this petition: the Douglas Indian Association, the Ketchikan Indian Community, the Metlakatla Indian Community, the Organized Village of Saxman, and the Wrangell Cooperative Association.

IV. HARD-ROCK MINING IN THE TRANSBOUNDARY WATERSHEDS OF THE TAKU, STIKINE, AND UNUK RIVERS THREATENS NATIVE COMMUNITIES LIVING IN SOUTHEAST ALASKA

19. For millennia, Alaska Native communities have depended upon the transboundary watersheds of the Taku, Stikine, and Unuk rivers in Southeast Alaska for their livelihoods and their spiritual and cultural practices.² Fish from these watersheds – particularly salmon and eulachon – have historically been, and continue to be, an important source of food and a centerpiece of cultural practices and spiritual beliefs.³ Families in Petitioners' communities have passed these cultural and spiritual practices on to younger generations.
20. Two hard-rock mining projects are operating and four new ones are proposed in the upper reaches of the Taku, Stikine, and Unuk river watersheds in British Columbia, Canada, near the border with Alaska. These projects are upstream of the waters in which salmon and eulachon spawn and rear, and of where the Southeast Alaska Native communities harvest fish. These mines are large-scale industrial projects that will generate huge quantities of acid-producing and toxic waste products. As described below, these projects threaten to pollute downstream waters with dissolved heavy metals, which are highly toxic to fish. Any substantial increase in the concentrations of these heavy metals in the watersheds could cause sustained and significant population declines to salmon and eulachon in downstream waters, and curtail Petitioners' ability to continue to practice their subsistence way of life and culture. The locations of the six B.C. Mines, the three watersheds, and the Southeast Alaska native communities are shown on the below map, a larger version of which is also appended to this petition as Appendix 4.



A. CULTURE AND SUBSISTENCE PRACTICES RELATED TO FISHING IN SOUTHEAST ALASKA NATIVE COMMUNITIES LIVING NEAR THE CANADA-U.S. TRANSBOUNDARY WATERSHEDS

1. THE TAKU, STIKINE, AND UNUK RIVER WATERSHEDS

21. Many families in Petitioners' communities use the three watersheds downstream from the six B.C. Mines for subsistence fishing, which is integral to maintaining their livelihoods and the traditional cultural and spiritual practices passed down from their ancestors for generations.

The Taku River Watershed

22. Members of the Douglas Indian Association fish for king, coho, and sockeye salmon at the inlet of the Taku River as well as around Douglas Island, southwest of Taku Inlet. The Taku River watershed is the largest unprotected wild river system on the northwest coast of North America.⁴ It covers 11,500 square miles (29,800 square kilometers) of ice fields, tundra, and temperate forest landscapes.⁵ The Taku River and its tributaries flow through three different biomes and terrestrial ecoregions as they weave from headwaters in northwestern British Columbia to the Pacific Ocean near Juneau, Alaska.⁶ The Taku River watershed is inhabited by at least 32 fish species, including all five species of Pacific salmon, steelhead trout, Dolly Varden, cutthroat trout, eulachon, longfin smelt, Pacific lamprey, round white fish, slimy sculpin, and threespine stickleback.⁷

The Stikine River Watershed

23. Alaska Natives have fished the Stikine River for centuries, and "the mouth of the river is one of [Wrangell Cooperative Association's] most important fishing areas."⁸ Britany Kee' ya aa. Lindley, a member of the Wrangell Cooperative Association, says that her parents

taught us that people have been fishing the Stikine for generations; we have always and will always do so. Historically, the Stikine Tlingits would disassemble their houses in the spring, all the way to the foundation, and transport them to upriver fish camps for the fishing season. Today, we continue the tradition of subsistence fishing.⁹

24. The name “Stikine” means “great river” in the Tlingit language.¹⁰ The Stikine River runs 335 miles (539 kilometers) from its headwaters in the Coast Range Mountains of British Columbia, across the Canada–United States border to its mouth near Wrangell, Alaska.¹¹ The waters of the Stikine are inhabited by several species of fish, including by all five species of Pacific salmon; steelhead, cutthroat, rainbow, bull, and lake trout; Dolly Varden; mountain whitefish; Arctic grayling; lake chub; longnose sucker; burbot, Pacific lamprey; slimy, prickly, and coast range sculpin; longfin smelt; eulachon, and threespine stickleback.¹² The Stikine River is one of the most important spawning rivers for Chinook salmon in Alaska.¹³



Stikine River near Wrangell, Southeast Alaska.
Photo used with permission.

The Unuk River Watershed

25. The Metlakatla and Ketchikan Indian Communities’ territories are in the watershed of the Unuk River, which runs from the coastal mountains of British Columbia into the marine waters of Alaska’s Inside Passage.¹⁴ The Ketchikan Indian Community has a long history of using the area as a fish camp.¹⁵ Members of the Metlakatla Indian Community have harvested eulachon for thousands of years on the Unuk River.¹⁶ As Louis Wagner, an elder in the Metlakatla Indian Community and a descendant of the Tlingit people of Cape Fox Village, explains,

Our people go back thousands of years fishing on the Unuk River. My family has been the hereditary caretaker of the river going back thousands of years. As caretakers, our family’s crest can be seen marked on painted pictoglyphs at the mouth of the Unuk River, as well as at points upstream. The crest has been tested and is thousands of years old. It depicts a sun with rays; the bottom edge was rubbed off by ice, with the grooves still evident. Since my childhood, my family has exercised our traditional rights to fish ooligan [eulachon] on the Unuk River.¹⁷

26. Around 80 miles (129 kilometers) long, the Unuk River drains a watershed of 1,500 square miles (3,885 square kilometers).¹⁸ From its headwaters in a heavily glaciated area in British Columbia, south of the lower Iskut River, the Unuk flows west and south, crossing into Alaska and emptying into Burroughs Bay, an inlet of Behm Canal.¹⁹ Despite its relatively small size, the watershed is a place of important biodiversity. The river teems with fish, including eulachon; steelhead, rainbow, bull and cutthroat trout; all five North American species of Pacific salmon; and mountain whitefish.²⁰



Upper Unuk River, British Columbia, Canada.
Photo used with permission

27. The U.S. government has protected the American half of the Unuk watershed as part of the Misty Fjords National Monument.²¹ The Canadian government has also protected some areas of the watershed within Border Lake Provincial Park.²² Because of declines in eulachon stocks in the Unuk River, the Alaska Department of Fish and Game has closed the eulachon fishery there annually since 2004, including for subsistence fishing.²³ In recent years, members of the Metlakatla and Ketchikan Indian Communities have argued that returns have climbed to pre-2004 levels and are hopeful that the fishery will reopen so that they can continue their tradition of subsistence eulachon harvests.²⁴

2. THE IMPORTANCE OF SUBSISTENCE FISHING FOR SUSTAINING PETITIONERS' LIVELIHOODS

28. Salmon and eulachon fishing is an essential subsistence practice among Southeast Alaska Native communities in the Taku, Stikine, and Unuk watersheds. These communities typically harvest salmon using gillnets, set nets, or trolling lines from boats.²⁵ Salmon are then processed and preserved in many ways, including smoking, canning, or freezing.²⁶ Eulachon are known colloquially as "hooligan" or "ooligan." They are harvested using float, seine, or dip nets, and are processed by smoking or fermentation. The oil is rendered to produce eulachon grease.²⁷



Hooligan from Stikine River are harvested with weighted nets. *Photo by Jennifer Miller, courtesy of SEITC*

29. Harvests of salmon and eulachon sustain Southeast Alaska Native communities throughout the year.²⁸ These harvests are central to Petitioners' livelihoods.²⁹ For example, James Stough, Sr., an elder in the Wrangell Cooperative Association, explains that his

family eats salmon “five to six days a week.”³⁰ To sustain themselves through one winter and part of the next summer, his family

put up 50 cases of one-pound tin cans [of salmon] with a 24-count per case. This was mostly smoked and canned. In addition to this, we put up dry salmon and halibut, smoked trout, and we froze an estimated 200 pounds of the different types of salmon for each winter.³¹

30. The subsistence harvest is critical as a source of food and to the economic livelihood of Britany *Kee’ ya aa*. Lindley and others in Wrangell’s indigenous community. Wild game and fish are her family’s main food supply, and she shares these with her extended family and the elders in the community. She explains:

We rely on the fish, game, and vegetation we harvest for food: our freezer is 90 per cent wild fish and game, and, beyond our own consumption, we share with our extended family and the elders in our community. As a couple with three daughters, my parents utilized subsistence harvests to provide plentiful healthy food for our family. Further, it helped my parents be able to put their earnings towards home ownership and supporting their children in all of our endeavors. Subsistence fishing has similarly supported many other, perhaps even most, families in Wrangell’s indigenous and nonindigenous community. The importance of this support has been evident in my lifetime, a time during which Wrangell has experienced dramatic economic changes, not least the transition out of a reliance on the logging industry to commercial fishing and tourism, once the Wrangell pulp mill was shut down.³²

31. Subsistence fishing also provides a nutritious food source³³ that is difficult for some to replace in the cash economy because similarly nutritious store-bought foods are expensive or are unavailable in remote locations.³⁴ As Tammi Meissner, a member of the Wrangell Cooperative Association, explains,

Our traditional harvesting practices are important to our livelihood, and to safeguarding our family’s welfare, especially given Wrangell’s location off of the continental road system. For example, I remember on September 11, 2001, when traffic was halted by plane and boat, no supplies could come into Wrangell through normal commercial networks.



Wrangell, home of Wrangell Cooperative Association, sits near the mouth of Stikine River in Southeast Alaska. Photo used with permission

The grocery shelves emptied in hours, and our community was reminded of the importance of our relationship with the land.³⁵

32. The Alaskan government has estimated that “the cost of replacing the wild food harvested by rural Southeast residents with retail purchases of equivalent food run[s] from \$22 to \$35 million annually.”³⁶ In Petitioners’ communities, where the average per capita income can be as low as \$20,315, purchasing wild salmon and/or eulachon multiple times a week would be difficult.³⁷

3. CULTURAL AND SPIRITUAL PRACTICES ASSOCIATED WITH SUBSISTENCE FISHING

33. Petitioners have long-standing and vital cultural practices associated with subsistence salmon and eulachon fishing in and around the Taku, Stikine, and Unuk watersheds. Continuing these practices is central to the maintenance of their culture identity – the sense of attachment that comes from belonging to a social group. For example, John Morris, Sr., tribal elder and council member of the Douglas Indian Association, explains that

[t]raditional subsistence harvest on the Taku is a way of life. It is central to our culture. ... I was taught to respect the river because it provided so much for us. We were taught never to mistreat the river and its watershed, always to leave it the way we found it. We never took anything more than we could use – fish, game, berries – and never wasted anything. Once I was on the river with a member of the U.S. Forest Service. He asked me to point out sacred sites on the Taku River. I told him that this whole place is sacred. I imagine that all twenty tribal governments in Southeast Alaska share that feeling.³⁸



Salmon harvested from the Taku River. Photo by Marina Anderson

34. Tammi Meissner says,

Salmon is the staple harvest in our traditional culture. You could say it is the heartbeat of our culture. If the salmon heartbeat is gone then ours will be gone too.³⁹

35. According to Britany Kee’ ya aa. Lindley, “[A] feeling of connection with the land and its life” is

[c]entral to my Tlingit culture.... Protection of the Stikine River is thus a part of my culture. According to legend, the Stikine Tlingits emerged from under the icefield at the headwaters of the Stikine. In our origin story, the people saw the green beyond the icefield,

ventured out, and settled at the mouth of the River.... We harvest animals for both sustenance and art, and we always respect them and are grateful for what they provide.... We also work to preserve the fish habitat so that our people will be fed forever.⁴⁰

For this reason, the Stikine River “is culturally and spiritually central to our people.”⁴¹

36. Subsistence fishing is also essential to maintaining Petitioners’ culture and heritage because it is an important way that the elders educate the younger members of society in traditional ways of life and kinship and bonding.
37. As Tammi Meissner explains,

Subsistence harvests on the Stikine River, including salmon fishing, are not only about economics. It is a traditional way of living that has been passed down to my children through several generations. My 92-year-old grandmother for example, told me stories about hanging salmon upon wood stakes. Fishing provides a center for social life in our community as well. I can remember many times when, after a productive day on the river, we would invite families together to process our catch together. When I was young, I did not speak much during these meetings, but rather sat and listened to the elders. I heard so many stories during these get-togethers, so important to my knowledge and identification with my community and culture. ... I have taught both of my daughters to fish, to smoke and can our harvests, and to ration harvesting and consumption sustainably. One day, I hope my grandchildren will also carry on these traditions.⁴²



Hooligan from Stikine River are harvested with weighted nets.
Photo by Jennifer Miller, courtesy of SEITC

38. Louis Wagner had a similar experience as a child, and now fishes with his son:

Since my childhood, my family has exercised our traditional rights to fish ooligan on the Unuk River. I first joined the trip to the river on a trawler when I was nine; I fished with my brother Walter Wagner and later, from when he was four years old, my son.⁴³

39. Petitioners educate the younger generations about cultural practices and the importance of fishing. For example, John Morris, Sr. explained that the Douglas Indian Association holds a cultural camp in the summer to teach traditional fishing and fish processing to the

youth, in addition to teaching them about the land, the Tlingit language, and their history.⁴⁴ His granddaughter was educated in the program.⁴⁵ These programs are essential to maintaining the tribe's way of life and their cultural connection to the Taku River.⁴⁶

40. The Douglas Indian Association has found a place on the Taku with old fishing nets, pottery, stoves, plates and cups that indicate that it was once a Tlingit fishing community with a school. According to John Morris, Sr., the association plans to

*create a cultural center to educate the younger generation about who they are, their culture, respect of the land, respect of the river, a place where carvers could work, and where we could take our young people to learn about the Taku River, catching the salmon, showing them how to clean them, strip them, prepare them for the smoke house and smoke them, and can them – everything from start to finish.*⁴⁷

41. Similarly, Tammi Meissner has worked as a traditional foods educator for the Southeast Alaska Regional Health Consortium, a non-profit tribal health consortium of Native communities in Southeast Alaska.⁴⁸ She explains that in that role she has

worked with elders in Southeast Alaska Native communities to gather and shared the knowledge learned with those in the community of Wrangell. ... I shared and continue to share our traditional methods of preparing foods, and eating healthy, but also about our Tribal values such as “Respect for self, Elders and Others, Respect for Nature and Property, and We are Stewards of the Air, Land and Sea.”⁴⁹

42. The sharing of the fish harvests with elders and others from within and outside of the community is also a key component of maintaining and strengthening tribal and communal cultural and social connections.⁵⁰ For Petitioners and other Alaskan Native communities, gifting subsistence foods within the community creates a “village-wide interdependency” and helps maintain larger networks.⁵¹ This tradition values not letting any of the harvest go to waste,⁵² sharing with the entire community,⁵³ and consequently allowing for households to stay intact and in the village community.⁵⁴ Gift-giving and bartering of fish products with other Native communities in Southeast Alaska renews ties and maintains relationships between villages that date back generations. As Einar Haaseth, an elder in the Wrangell Cooperative Association, explains,

Harvests from the Stikine River and its surrounding lands are not only about filling the freezer for the winter. ... [W]e also give a lot of the food we catch or hunt away to friends and other members of the community, especially the elderly and the disabled. We have a tradition when you give someone cooked or smoked fish that they always take off a little piece of the fish and eat it right then and there to show thanks. My grandma instilled in me this tradition of

bringing gifts with you wherever you go and always acknowledging and thanking others.⁵⁵

43. James Stough, Sr. was taught to do the same. For him,

[s]haring knowledge of harvesting... is as important as the harvesting of fish and animals, because we share our stories, knowledge and customs. This helps us connect as a family and community.⁵⁶

44. For Louis Wagner, the social ties maintained through sharing the fish harvest extend beyond his local communities of Ketchikan and Metlakatla, also creating

ties with other Native communities in Southeast with whom we could exchange gifts of smoked ooligan for their regional foods. These are ties that allow us to stay in touch and to support each other.⁵⁷

45. In addition to maintaining social connections, sharing fish harvest serves an important cultural purpose. As Britany Kee' ya aa. Lindley explains,

Trade and gift-giving of subsistence fish not only tie our families and communities together, but also maintain our culture.⁵⁸

B. THE SIX B.C. MINES THREATEN THE FISH STOCKS THAT ARE CENTRAL TO PETITIONERS' CULTURE, SPIRITUALITY, AND MEANS OF SUBSISTENCE

46. Over the past years, six hard-rock mining projects have been proposed in the upper reaches of the Taku, Stikine, and Unuk river watersheds, directly upstream of where Petitioners and their communities harvest fish for cultural and subsistence use. These mines are at different stages: two are operating, one has its permits approved but is in receivership, and three are in the licensing process.

47. These six mines are large-scale industrial projects that will generate huge quantities of waste that can cause acid mine drainage, a toxic cocktail of acidic water and dissolved heavy metals. Most of the mines also use or will use a highly risky method of storing toxic byproducts in wet dam enclosures that could catastrophically pollute the surrounding watersheds. As described below, these projects threaten to pollute downstream waters that Petitioners use, with potentially significant effects on the populations of salmon and eulachon that they harvest. Moreover, as discussed below, despite the threats these mines pose, British Columbia and Canada are unlikely to prevent the harm they are causing.



Taku River salmon.
Photo by Chris Miller - csmphotos.com

1. HARD-ROCK MINING POLLUTES THE ENVIRONMENT THROUGH CHRONIC HEAVY METALS POLLUTION AND THE CATASTROPHIC FAILURE OF MINE WASTE CONTAINMENT SYSTEMS

48. The hard-rock mining process generates toxins that, if released to the environment, pose severe threats to downstream aquatic life. A primary threat originates in pollution generated by mining waste products. In the process of accessing and removing ore, mining operations displace and remove large quantities of waste rock,⁵⁹ which is often stored in a designated dump area or used to backfill an underground mine chamber once extraction is completed.⁶⁰ The processing of ore also produces a waste slurry of rock particles suspended in water, known as tailings.⁶¹ Waste rock and tailings can both generate toxic pollution, which can reach the environment through two primary pathways: chronic leaching and catastrophic failure of containment systems.⁶²
49. As described in this section, processes for treating and containing these wastes have failed to prevent chronic and catastrophic toxic pollution from mines in British Columbia and elsewhere around the world.
 - a. *Chronic heavy metals pollution*
50. One of the most damaging sources of water pollution from mining is a toxic mix of acidic water and dissolved heavy metals known as acid mine drainage.⁶³ Acid mine drainage is generated when water flowing from mine sites is acidified by contact with sulfide rock that has been exposed to oxygen.⁶⁴ Mining activities in sulfide rock include breaking the rock to access and extract ore, as well as milling it into fine particles during the ore-processing stage.⁶⁵ These activities increase the surface area of the sulfide rock, enabling more acid generation.⁶⁶ Acidic waters dissolve heavy metals in the rock, releasing them into the surrounding environment.⁶⁷ Where acid mine drainage flows into rivers, streams, or aquifers, it can cause significant harm to aquatic life.⁶⁸
51. To mitigate the generation and release of acid mine drainage to the surrounding environment, mine operators attempt to segregate acid-generating rock and acidic waters from the environment, using networks of liners, ditches and ponds.⁶⁹ They can also use active and passive methods to treat polluted waters before releasing them into the environment.⁷⁰ A common active treatment method is to add lime to reduce acidity and allowing metals to precipitate out of solution in settling ponds.⁷¹ Passive treatment involves a self-operating system that can treat acid mine drainage without constant human intervention.⁷² For example, when acid mine drainage is passed through an artificial wetland, organic matter, bacteria, and algae can filter, absorb, and precipitate out the heavy metal ions and reduce the acidity.⁷³
52. Containment and treatment often does not perform as planned. For example, infrastructure often fails to contain polluted waters, and treatment processes often fail to reduce acidity or remove metals adequately.⁷⁴ Moreover, because the oxidization process that generates acid mine drainage persists over centuries, containment and treatment techniques must work for centuries, which is much longer than the operational life of a mine.⁷⁵ Given these issues, pollution from chronic acid mine drainage is a common

problem where hard-rock mining occurs in sulfide deposits, as is the case with the six mines at issue in this petition.

53. The difficulty of containing acid mine drainage over decades is evident in the case of the Tulsequah Chief Mine in British Columbia. Although mine, located at the same site as one of the proposed B.C. Mines, ceased operations in 1957, toxic acid mine drainage from the mine has polluted the watershed since its closure.⁷⁶ A 2016 study commissioned by the government of British Columbia found that “multiple undiluted and untreated sources of historic mine waste are discharging into the Tulsequah mainstem and side channels from surface water and groundwater inputs,” posing “unacceptable risks to fish, fish eggs, and pelagic invertebrates.”⁷⁷ Although the government issued a pollution abatement order in 1989, few steps were taken to stop the acid mine drainage.⁷⁸ In 2011, as part of an agreement to re-open the mine, Chieftain Metals agreed to build a water treatment plant to stop the acid mine drainage.⁷⁹ But the company shut the plant after less than a year because of high operating costs.⁸⁰ Another non-compliance order issued by the government in November 2015 also failed to achieve any action. Chieftain entered receivership in September 2016⁸¹ and acid mine drainage continues to leach out of the mine site.⁸² The B.C. government has thus failed to stop the pollution for decades.

54. In another example, at the Buckhorn underground mine in Washington State, operators have been unable to control contaminated groundwater, which is reaching surface waters.⁸³

55. As discussed below, there is no evidence that British Columbia or Canada are doing anything to prevent the same situations from occurring at any of the six mines at issue in this petition.

b. *Catastrophic pollution from wet tailings dams*

56. In addition to leaching out as acid mine drainage, toxic pollution from hard-rock mines can reach the environment through catastrophic failures of tailings containment systems.⁸⁴

57. Tailings are one of the main wastes produced by mining activities. In order to remove and process the metals present in rock, ore is crushed and ground into fine particles at a mill.⁸⁵ The rock particles are then suspended in water from which concentrated metals are separated using a combination of mechanical and chemical techniques.⁸⁶ The leftover waste slurry is referred to as tailings.⁸⁷



Acid Mine Drainage from the old Tulsequah Mine collects in a retaining pond adjacent to the Tulsequah River. Photo by Chris Miller - csmphotos.com

58. Tailings are disposed of using either a dry or a wet technique.⁸⁸ Wet disposal or wet closure entails depositing the tailings underwater in a pond to slow the oxidation process.⁸⁹ The pond is often separated from the surrounding environment by a dam.⁹⁰ Given the timeframe of oxidation and acid generation from the tailings, these dams must stand for millennia.⁹¹

59. In a report attached as Appendix 1, Dr. David Chambers, an expert with 40 years of experience in mineral exploration and development, explains that these types of tailings dams present risks of catastrophic failures that can release huge quantities of acid mine drainage into downstream surface waters.⁹²

60. A number of factors make failure likely. First, because the dams are often raised incrementally over many years as tailings accumulate over the mine's operating life, quality control is difficult to ensure.⁹³ Also, the tailings themselves can be used for partial, or sometimes full, support of the dam.⁹⁴ These underlying tailings may be unstable, however, because they can remain saturated and liquefy under pressure or during an earthquake, compromising the integrity of the dam built on top of them.⁹⁵

61. During the century or so of their use, over two hundred tailings dam failures have been reported.⁹⁶ An increasing proportion are serious failures (ones large enough to cause significant harm to ecosystems and people), with 49 percent of serious failures occurring since 1990.⁹⁷ For example, in November 2015, the Fundão tailings dam in Minas Gerais, Brazil, failed in what has been described as the world's biggest environmental mining disaster.⁹⁸ The failure may have been caused by small seismic shocks⁹⁹ causing liquefied mud under the earthen dam to collapse under the mass of impounded tailings.¹⁰⁰ About 43 million cubic meters of tailings escaped through the breach, generating 10 meter-tall waves of toxic mud.¹⁰¹ The resulting flood killed 19 people¹⁰² and polluted 668 kilometers of waterways, from the Doce River to the Atlantic Ocean.¹⁰³ The released tailings "caused severe changes to the physico-chemical characteristics of the Doce River and estuarine region" and at places turbidity increased 6,000 fold.¹⁰⁴ Large numbers of fish were killed by toxic pollution in the water.¹⁰⁵

62. The Fundão dam spill affected waters relied on by forty downstream municipalities and left hundreds of thousands of people without access to clean water.¹⁰⁶ Among the communities affected were the indigenous Krenak people who lived in seven villages along the Doce River.¹⁰⁷ Before the disaster, the Krenak "would hunt fish, capybaras, armadillos and other animals, and use the Rio Doce for drinking water and to irrigate their crops"; since the disaster they "eat beef, chicken and pork bought at nearby supermarkets."¹⁰⁸ In the words of one village elder,

We live to hunt and to fish and now we cannot.... [O]ur Native diet is fish. But for us, the river died.¹⁰⁹

63. The failure of the Fundão dam and the resulting damage occurred even though the dam was only seven years old and contained substantially less tailings (56.4 million cubic meters) than it had been designed to hold (111.6 million cubic meters).¹¹⁰

64. Canada is not immune to catastrophic tailings dam failures. According to a United Nations Environment Programme assessment, Canada's seven tailings spills were the second-most in the world between 2007 and 2017.¹¹¹ One of these – a 2014 spill at the Mount Polley Mine in British Columbia – was one of the worst tailings disasters in the world, and illustrates problems in tailings dam regulation in British Columbia.
65. On August 4, 2014, a tailings dam collapsed at Imperial Metal's Mount Polley copper and gold mine in British Columbia.¹¹² The breach opened suddenly, giving the mine operator no warning¹¹³ and releasing approximately 254 million cubic meters of toxic tailings slurry into salmon-bearing downstream waters.¹¹⁴ The tailings and polluted water widened a downstream creek from five meters to a width of over 100 meters.¹¹⁵ The toxic tailings rushed downstream, killing fish and destroying and contaminating Indigenous people's lands and waters they had used for generations.¹¹⁶ The full extent of the environmental, economic, and cultural damage from this disaster may remain unknown for decades.¹¹⁷
66. In response to the Mount Polley dam failure, the British Columbia government convened an expert panel to investigate the disaster and to recommend government actions that could ensure such failures would not occur again.¹¹⁸ The panel concluded that the dominant cause of the dam failure was that its design did not account for stresses that the dam structure would have to bear because of its geological surroundings and the dam's slope.¹¹⁹
67. Alarmingly, the panel predicted that if mines in British Columbia continued to use the same wet tailings storage technology as the Mount Polley mine, there would be two tailings dam failures every ten years.¹²⁰ The panel concluded:

Such high probabilities and numbers of future failures are incompatible with safety goals for either evaluation period. [British Columbia's] portfolio risk is clearly excessive for ensuring that similar failures do not occur at other mine sites in B.C. ... The historic failure frequency provides clear evidence that past practices and technologies have failed to provide acceptable levels of tailings dam safety in the province from a portfolio risk point of view.¹²¹
68. The panel recommended that in the future mine projects avoid impounding saturated tailings under water behind dams.¹²²
69. To date, British Columbia has ignored the panel's recommendation. As a May 2017 report on the failures of British Columbia's mining system by the University of Victoria's Environmental Law Centre concluded, the Government of British Columbia has failed to commit to the expert panel's most significant recommendation – that the province systematically transition from building large tailings ponds to the safer technology of putting tailings underground, with dry/filtered tailings on the surface.

Despite the panel's warning that two tailings dams will likely fail every decade, [British Columbia] has failed to follow through. It is clear that [British Columbia] has failed to address the core systemic issues that led to the Mt. Polley disaster.¹²³

70. As discussed below, five of the six B.C. Mines will use the same wet tailings dam design that the panel recommended against. In some cases, British Columbia authorized the use of this flawed design after the panel's recommendation.

2. THE INADEQUATE REGULATION AND ENFORCEMENT OF MINING IN BRITISH COLUMBIA

71. Recent reviews have found the government of British Columbia's regulation of mining inadequate.¹²⁴ Mining in the province is primarily overseen by the Ministry of Energy, Mines and Petroleum Resources, which regulates activities on the mine site, and the Ministry of Environment, which regulates a mine's potential impacts to the environment.¹²⁵ Unfortunately, these agencies are conflicted and unable to regulate mines adequately to avoid further spills and contamination.¹²⁶

72. In 2016, prompted by the Mount Polley disaster, British Columbia's Auditor General audited the performance of these agencies. She found "a decade of neglect in compliance and enforcement activities within the Ministry of Energy and Mines, and significant deficiencies within the Ministry of Environment's activities."¹²⁷

73. The Auditor General found that the Ministry of Environment compliance and enforcement activities do not adequately protect against "significant environmental risk."¹²⁸ The ministry has insufficient resources, including inadequately trained and qualified staff,¹²⁹ "declining staff morale"¹³⁰ that has led to an "exiting of staff with mining experience,"¹³¹ and poor coordination with the Ministry of Energy, Mines, and Petroleum Resources¹³² all of which increase "the likelihood of environmental risks not being addressed."¹³³ As an example of poor enforcement, the Auditor General pointed to the ministry's inadequate oversight of a coal mining project in the Elk River watershed (a transboundary river flowing from British Columbia into Montana).¹³⁴ Despite knowing that the mine operator's discharges of selenium to an already polluted watershed in excess of its permit level would likely harm the environment, the ministry did not suspend the mine's operations, but instead authorized the mine's expansion.¹³⁵ Given the transboundary nature of the watershed, the Auditor General concluded that "[t]here is a risk that if [the Ministry of Environment] is unable to enforce [the mine permit] and the mine company exceeds its permit limit for selenium [in transboundary waters,] the outcome could be a violation of the 1909 [Boundary Waters] Treaty."¹³⁶

74. The Auditor General also found that the Ministry of Energy and Mines' compliance and enforcement activities were inadequate to protect the environment, and its "expected regulatory activity" was "deficient."¹³⁷ For example, in connection with the Mount Polley disaster described above, the audit found that the ministry adopted generic dam-building standards that were "not specific to the conditions in B.C. or specific to tailings dams[,] ... result[ing] in a tailings dam that was built below generally accepted standards

for tailings dams.”¹³⁸ More specifically, the ministry “did not ensure that the [Mount Polley] tailings dam was being built or operated according to the approved design” and failed to “ensure that the mining company rectified design and operational deficiencies.”¹³⁹

75. The Auditor General also identified structural problems that undermine the ability of the Ministry of Energy and Mines to ensure that mining operations do not cause environmental harm. Although the ministry has a dual mandate to both promote and regulate resource development in the province,¹⁴⁰ the Auditor General found that it devotes “[m]ost ... efforts ... to supporting the development of mining.”¹⁴¹ She concluded that “most of [the] signs [exist] which can give rise to a reasonable perception of, and increase the actual risk of, regulatory capture” in which the ministry “created to act in the public interest, instead serves the interests of [the mining] industry.”¹⁴² She recommended that the government create an “integrated and independent compliance and enforcement unit for mining activities, with a mandate to ensure the protection of the environment . . . [with] our expectation that this new unit would not reside within” the Ministry of Energy and Mining.¹⁴³
76. The University of Victoria Environmental Law Centre’s March 2017 report affirmed the Auditor General’s findings. According to this report, there is “irrefutable evidence that the provincial mine regulatory system is in a state of profound dysfunction,” and a “series of major systemic failures demonstrate the need for wide-ranging reform.”¹⁴⁴ Some of these failures include:
 - The Mount Polley Mine disaster;
 - Failures of provincial enforcement of mining laws;
 - Failure to inspect a closed mine for over 20 years, allowing the undetected destruction of a salmon river;
 - Failure of provincial rules for environmental assessment to meet global best practices;
 - Failures of provincial placer mining rules to protect rivers and streams; and
 - Failure of a 19th-century gold rush law to protect First Nations land and environmentally sensitive areas.¹⁴⁵
77. The report also found that the government of British Columbia has failed to address the concerns of the Mount Polley expert panel regarding the use of highly risky wet tailings impoundments.¹⁴⁶
78. Dr. Chambers assessed British Columbia’s mining regulatory and/or enforcement practices and agrees that British Columbia regulators do not make safety the primary consideration in the design, construction, operation, and closure of tailings dams.¹⁴⁷ In reaching this conclusion, Dr. Chambers referred to the B.C. government’s authorization of five of the B.C. Mines to use tailings dams that have the same basic design as the Mount Polley dam – including authorizing some of these dams after having been informed of the expert panel’s recommendation against precisely this design.¹⁴⁸

79. The failure of the governments of British Columbia and Canada to prevent environmental damage from mines, including from catastrophic tailings dam failures, creates a significant and imminent risk of environmental damage to the watersheds from the B.C. Mines discussed below.

3. THE B.C. MINES THREATEN THE TAKU, STIKINE, AND UNUK WATERSHEDS

80. The mines at issue in this petition pose the same risks associated with acid mine drainage and tailings dam failures described above. All six mines are associated with sulfide deposits that will generate acid mine drainage, threatening downstream watersheds with chronic heavy metals pollution. In addition, as detailed below, five of these projects will use the same basic tailings dam design as the ones that failed at Mount Polley, but at much larger scales.¹⁴⁹ Four of these mines have located their dams in either the Taku and Stikine watersheds and pose a significant risk of catastrophic pollution events.¹⁵⁰

81. The risks of pollution from the B.C. mines are discussed in detail in the report of Dr. David Chambers.¹⁵¹

a. *The Tulsequah Chief Mine*

82. Within the Taku River watershed, directly upstream of the Douglas Indian Association's traditional salmon fishing grounds and near the U.S.-Canada border,¹⁵² the Chieftain Metals Corporation¹⁵³ has proposed to construct and operate the Tulsequah Chief Mine.

83. The mine is planned to extract gold, silver, copper, lead, and zinc from a 54 square-mile (139 square-kilometer) property on the east side of the Tulsequah Valley in British Columbia, near the confluence of the Tulsequah and Taku rivers.¹⁵⁴ The mine site would be 16 kilometers upstream of the U.S. border, and 64 kilometers northeast of Juneau, Alaska.¹⁵⁵ The project encompasses two ore deposits, the Tulsequah Chief deposit and the Big Bull deposit, both of which Chieftain Metals plans to develop.¹⁵⁶ Cominco operated a mine at the same site from 1951 until 1957¹⁵⁷ that, as described above, is currently polluting the Tulsequah River with acid mine drainage since its closure.¹⁵⁸

84. Over its 11-year proposed operating life, the mine is expected to produce 4.4 million metric tons of ore.¹⁵⁹ Ore will be mined and crushed underground, then fed into a mill for grinding on site.¹⁶⁰ Doré (a gold-silver alloy), copper, lead, and zinc concentrate will be extracted onsite.¹⁶¹ For a few months a year, barges will transport ore concentrate and supplies down the Taku River from the mine to a transshipment site where material would be transferred to ocean-going barges for international shipment.¹⁶²



The proposed Tulsequah Chief Mine sits along the Tulsequah River, a tributary to the Taku River, 10 miles upstream from the U.S.-Canada border.

Photo by Chris Miller - csmphotos.com

- 85. The project is expected to produce over 2.16 million metric tons of tailings,¹⁶³ 1.76 million metric tons of which will be impounded in a 45-hectare wet impoundment within the Taku drainage.¹⁶⁴ This impoundment uses the same design as the dam that failed at the Mount Polley Mine.¹⁶⁵ The company plans to neutralize acidic wastewaters by treating them with limestone.¹⁶⁶ As Dr. Chambers explains, this kind of containment and treatment often does not perform as planned.¹⁶⁷
- 86. The government of British Columbia approved the mine in 2002,¹⁶⁸ and all permits needed to start construction have been granted.¹⁶⁹ Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process or at any other time, as required by international law (see section V.C.5.).
- 87. In 2016, Chieftain Metals, the proponent of the Tulsequah Chief Mine project, went into receivership.¹⁷⁰ The company is currently seeking a buyer for the mine.¹⁷¹

b. The Red Chris Porphyry Copper-Gold Mine

- 88. In the Stikine watershed, upstream of the traditional fishing grounds used by members of the Wrangell Cooperative Association, Ketchikan Indian Community, and Organized Village of Saxman, three hard-rock mines are in various stages of development.
- 89. The first of these mines, Imperial Metals Corporation's¹⁷² Red Chris Porphyry Copper-Gold Mine Project, began production in February 2015, before the project had secured its final permit from the government of British Columbia.¹⁷³ Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process at any other time.
- 90. Over its projected 25-year operating life, the Red Chris mine expects to process around 30,000 metric tons of ore per day.¹⁷⁴ The mine will generate 300 million metric tons of tailings,¹⁷⁵ which will be impounded in a Y-shaped valley that has been dammed at each of its three arms by earth-fill embankments.¹⁷⁶ The tailings impoundment drains into the Stikine River via two of its tributaries, the Iskut and Klappan rivers.¹⁷⁷
- 91. The tailings dam uses the same basic design as the failed Mount Polley Mine dam, contrary to the expert panel's recommendations.¹⁷⁸ In fact, the government of British Columbia provided the Red Chris Mine, which is operated by the same company that owns Mount Polley, a permit to use a wet tailings facility just days after the panel issued its report.¹⁷⁹ After the mine's first two years, the dams will be raised annually to contain additional tailings.¹⁸⁰



Red Chris Mine. Photo by Dan Mesec

92. The British Columbia Environmental Assessment Office predicts that seepage water with elevated concentrations of metals pollutants could potentially escape the impoundment and “enter the receiving environment.”¹⁸¹ The mine’s environmental assessment certificate application enumerates “[p]otential impacts to aquatic habitat associated with the tailings impoundment” that include the direct loss of habitat within the tailings impoundment footprint and decreased water quality in downstream waters.¹⁸² These impacts are expected to occur “during the lifetime of the project and into post-closure.”¹⁸³
93. Though environmental authorities concluded that the mine’s precautionary measures would rule out significant environmental problems beyond the mine site,¹⁸⁴ by December 2015, less than a year after the mine became operational, there had already been a tailings spill from the mine “caused by wear and tear” to a pipe.¹⁸⁵
94. In addition to tailings, the project is expected to generate 338 million metric tons of waste rock,¹⁸⁶ most of which will be deposited in a rock dump.¹⁸⁷ According to the environmental assessment report for the mine, “over time a significant proportion of the waste rock in the North waste dump and in the exposed pit wall rock is expected to become acid-generating[,] releasing increased concentrations of metal contaminants.”¹⁸⁸
95. During the mine’s operation, drainage from the dump will flow directly into the tailings impoundment area.¹⁸⁹ Afterwards, however, the drainage “will require treatment to produce an acceptable quality of effluent for release to receiving waters.”¹⁹⁰ For a period estimated to be “in excess of 200 years,” drainage from the dump will be directed back into the open pit, via either a rock trench or tunnel, where a treatment plant will operate to reduce its acidity.¹⁹¹ From there, the treated drainage will be directed to the tailings impoundment.¹⁹² Although the mine’s environmental assessment report notes that “[t]reatment will likely be required in perpetuity,”¹⁹³ there is currently no requirement or commitment that the mine proponent or any other party, including the British Columbia or Canadian governments, will provide the funding, personnel, access, or other resources to secure such treatment indefinitely.

c. *The Schaft Creek Mine*

96. Also in the Stikine watershed upstream of Petitioners’ traditional fishing grounds, Copper Fox Metals Incorporated¹⁹⁴ and Teck Resources Limited¹⁹⁵ have proposed an open pit copper, gold, molybdenum, and silver mine called the Schaft Creek Mine.¹⁹⁶ Over the mine’s 15-23 year proposed operating life, the project is expected to produce around 100,000 metric tons of ore per day.¹⁹⁷

97. It is estimated that the project would generate over 800 million metric tons of tailings.¹⁹⁸ These tailings would be impounded by rockfill embankments in Skeeter valley, which drains into the Stikine River via Skeeter and Schaft creeks.¹⁹⁹ Contrary to the Mount Polley expert panel's recommendations, this mine would also use a tailings dam with the same basic design as the one that failed at the Mount Polley Mine.²⁰⁰



The proposed Schaft Creek Mine is located in the Stikine River watershed. *Photo used with permission*

98. The project is also expected to generate over a billion metric tons of waste rock,²⁰¹ which will be dumped at sites around the perimeter of the mine pit, "with the majority of the material placed on the east side of Schaft Creek."²⁰² Ten percent of the waste, over 100 million metric tons, is expected to be potentially acid-generating.²⁰³

99. In 2016, the proponents withdrew the Schaft Creek project from the environmental assessment process.²⁰⁴ Although the project is not formally under consideration at this time, the proponents continue to develop it, approving \$900,000 in 2017 to complete environmental assessment and permitting.²⁰⁵ Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process or at any other time.

d. *The Galore Creek Mine*

100. The third mine in the Stikine watershed is the Galore Creek Mine to be operated by Newmont Mining Corporation²⁰⁶ and Teck Resources Limited.²⁰⁷ Over its 18.5-year operating life, the mine is expected to produce about 588 million metric tons of ore, with an annual yield of approximately 3.23 billion pounds of copper, 200,000 thousand ounces of gold, and three million ounces of silver.²⁰⁸

101. Most of the project's expected one billion metric tons of waste rock and tailings will be contained behind dams in a steep canyon.²⁰⁹ Contrary to the Mount Polley expert panel's recommendations, this mine would use tailings dams with the same basic design as the one that failed at the Mount Polley Mine.²¹⁰ Waste rock is expected to leach aluminum, antimony, boron, cadmium, copper, fluoride, iron, lead, manganese, molybdenum, selenium, sulphate, and zinc into the impoundment water.²¹¹ According to the environmental assessment prepared by the project proponents, "[e]ffluent from the mine site will be discharged from the tailings and waste rock impoundment into Galore Creek from mid-May to mid-October."²¹² The company maintains that this toxic "effluent will mix rapidly due to the highly turbulent nature of Galore Creek,"²¹³ diluting its content within the surface waters of the Stikine drainage. As described below, this would likely not prevent increases in metal concentrations downstream.²¹⁴

102. Although the government of British Columbia issued an environmental assessment certificate for the Galore Creek Mine in 2007,²¹⁵ changes in the proposed project have necessitated a new environmental assessment process.²¹⁶ The project proponents plan to invest up to USD 30 million annually over the next three to four years to complete a new prefeasibility study.²¹⁷ Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process or at any other time.

e. *The Brucejack Mine*

103. Upstream of where the Metlakatla and Ketchikan Indian Communities have traditionally fished for eulachon in the Unuk watershed, the Canadian government has approved one hard-rock mining project, and is evaluating another.

104. The first hard-rock mining project is the already-operational Brucejack Mine, a gold and silver mine operated by Pretium Resources Incorporated (Pretium).²¹⁸ The mine is located four kilometers from the KSM Mine near Brucejack Lake, which drains into the Unuk River via Brucejack and Sulphurets creeks, approximately 53 river-kilometers upstream from the U.S.-Canada border.²¹⁹ This project consist of an underground mine, a mineral processing plant, a waste rock and tailings impoundment, an aerodrome, and an access road.²²⁰ Doré and gold-silver concentrate is produced on-site and then trucked away.²²¹ According to Pretium's environmental assessment, the fully operational mine will produce around 2,700 metric tons of ore per day, and will do so over the mine's 22-year operating life,²²² for a total of almost 19 million metric tons of ore.²²³



Brucejack Mine. Photo by Pretium Resources

105. As much as 85% of the waste rock generated at the site²²⁴ – 4.87 million metric tons of waste rock – will be potentially acid-generating material.²²⁵ Pretium's environmental assessment notes that the mine's waste rock poses a risk of leaching arsenic, antimony, silver and cadmium.²²⁶ Although some portion of waste rock and tailings will be used to backfill the underground mine chamber at closure, the remainder will be piped to the bottom of Brucejack Lake.²²⁷

106. Brucejack mine received its final permits in September 2015 and began operations in June 2017.²²⁸ Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process or at any other time.

f. *The KSM Mine*

107. The second hard-rock mining project in the Unuk River watershed is the KSM Mine, located four kilometers downstream of the Brucejack Mine and approximately 22 miles (35 kilometers) from the U.S. border. Proposed by Seabridge Gold Incorporated (Seabridge),²²⁹ this gold, silver, copper, and molybdenum mine would be one of the largest undeveloped copper-gold projects in the world.²³⁰ The project consists of two parts, one of which is a mine site within the Unuk River drainage.²³¹ Over the course of its anticipated 51.5-year operating life, the KSM Mine would extract about 130,000 metric tons of ore per day²³² from three open pits and two underground cave mines,²³³ producing 2.16 billion metric tons of ore.²³⁴

108. According to Seabridge's environmental assessment, the mine will produce over three billion metric tons of waste rock and overburden over the course of its life.²³⁵ Seventy-one percent of the waste rock by weight will be potentially acid-generating, and the acid-generating potential of another 15 percent is "uncertain."²³⁶ Waste rock will be stored in dumps in rock storage facilities in the Unuk River drainage, and will also be used to backfill one of the mining pits once mining is completed there.²³⁷

109. Seabridge plans to divert water that has contacted disturbed areas or materials to a 63-hectare water storage facility²³⁸ in a dammed section of Mitchell Creek.²³⁹ From there, it will be pumped to the water-treatment plant²⁴⁰ to be treated with lime before being released into Sulphurets Creek, which flows into the Unuk River.²⁴¹ Seabridge claims that the water treatment and water storage facilities will continue to operate after closure of the mine "until discharge quality meets targets," a period expected to be around 250 years.²⁴² The company estimates post-closure treatment costs to be \$20,383,500 per year for basic treatment, and \$6,656,620 for the selenium treatment plant.²⁴³ These costs do not include replacement costs that would be expected to occur over the life of the water treatment plant, including replacement of moving parts (about every 10 years), stationary parts (about every 20 years) and plant itself (about every 50 years).²⁴⁴

110. As discussed in more detail below, the KSM Mine is the only one of the six B.C. Mines for which the proponents have assessed downstream water-quality impacts at the U.S.-Canada border from "normal" operation of the mine. Although Seabridge's environmental assessment predicts that its treatment of acidic wastewater will result in no increases in downstream concentrations of toxic metals other than selenium, Dr. Chambers concluded that the company's predictions are flawed and likely underestimate the downstream water quality impacts, and that downstream concentrations of metals are likely to increase from existing levels and that the increase could be substantial.²⁴⁵



The proposed KSM Mine is located in the upper Unuk River watershed. *Photo used with permission*

111. The project received provincial and federal environmental assessment certificates in 2014,²⁴⁶ and Seabridge is still seeking various other permits. Neither Canada nor British Columbia consulted with or sought the free, prior, and informed consent of Petitioners concerning the approval or operation of this mine during the approval process or at any other time.

4. HARM TO SALMON AND EUCHALON FROM MINING POLLUTION

112. Canadian authorities have not required proponents of the six B.C. Mines to assess impacts from the mine projects on downstream water quality in areas populated by the salmon and eulachon upon which Petitioners' subsistence way of life and culture depends. For five of the six mines, the proponents have not assessed potential changes to water quality in these downstream watersheds. Moreover, none of the proponents has assessed worst-case scenarios for downstream waters should their tailings dams fail.

113. Only the KSM Mine proponent, Seabridge, has assessed potential impacts of its mine on water quality downstream, including at the U.S.-Canada border, from normal mine operations. Because all of the B.C. Mines propose to use largely similar pollution mitigation strategies as the KSM Mine – neutralizing and precipitating metals out of solution before releasing waters to the environment – the KSM Mine provides a general picture of threats that might be expected from the other B.C. Mines.²⁴⁷ Thus, a critical evaluation of Seabridge's predictions and the potential harm to fish in downstream waters is relevant to a consideration of the likely impacts from each of the other B.C. Mines.

114. Seabridge does not deny that the KSM Mine will likely generate acid mine drainage. As part of its mine plan, Seabridge intends to capture waters that naturally contain metals, combine them with mine wastewater, and treat the combination before releasing it as effluent to the watershed.²⁴⁸

115. Seabridge acknowledges that these steps will not prevent an increase in concentrations of selenium in waters of the Unuk River downstream from the mine.²⁴⁹ As described below, increased selenium concentrations has serious detrimental effects on fish and other aquatic life. For other metals, Seabridge predicts that its operations would not increase, and in some cases would actually reduce, mean concentrations in downstream waters.²⁵⁰



Subsistence sockeye salmon harvesting

near Unuk River, Southeast Alaska.

Photo by Carrie Dodson, courtesy of SEITC

116. Dr. Kendra Zamzow and Dr. Chambers reviewed Seabridge's predictions and, for several reasons, concluded that they are misleading and may be overly optimistic for several reasons.²⁵¹
117. First, as described above, the containment and treatment methods planned by Seabridge and the proponents of the other B.C. Mines, and approved by the B.C. government, are unlikely to prevent chronic or catastrophic contamination of waters downstream from the mines.²⁵² The kind of containment dams proposed or constructed for these mines have failed in the past, and have been found by a panel of government experts to be unsafe. Moreover, as Dr. Chambers and Dr. Zamzow explain, no treatment process is adequate to prevent acid mine drainage pollution to surface waters.²⁵³
118. Second, Seabridge bases its conclusions on a predicted reduction in the total concentration of each metal in the water, including concentrations of both sediment-bound and dissolved forms of the metals.²⁵⁴ However, because dissolved metals are more bioavailable to fish and most harmful to aquatic life,²⁵⁵ concentrations of dissolved metals are more relevant to an assessment of potential harm.²⁵⁶ Because treatment of mine effluent may reduce total metals concentrations without reducing – and possibly allowing an increase in – concentrations of dissolved metals, it is impossible to assess water quality impacts based on total concentrations.²⁵⁷ In fact, for aluminum and iron, the only two metals for which Seabridge made both total- and dissolved-metals predictions, Seabridge's analysis predicted an *increase* in dissolved concentrations in the Unuk River despite a decrease in total metals concentrations.²⁵⁸ Based on Seabridge's own analysis, therefore, Dr. Zamzow concludes that Seabridge likely overstates the efficacy of its treatment plan, and understates risks the KSM Mine poses to the downstream aquatic life.²⁵⁹
119. Finally, Seabridge's analysis is based on questionable assumptions that cast its conclusions into doubt. For example, Seabridge assumed that metals will precipitate out of the Unuk River system at rates higher than were observed in segments of the river in baseline studies.²⁶⁰ Seabridge also tested its treatment techniques using simulated feed waters that were likely different from the water from the naturally metals-loaded stream, which would have led the company to underestimate the likely downstream metal concentrations.²⁶¹ Another questionable assumption was Seabridge's exclusion of the possibility of acid mine drainage seepage from the mine site through underground chambers and tunnels.²⁶² Such seepage would result in higher concentrations of contaminants in the receiving waters.
120. One of the most problematic assumptions in Seabridge's analysis was that its pollution capture and treatment process will work flawlessly over many decades.²⁶³ In Dr. Zamzow's experience, large industrial operations do not operate flawlessly, and the containment and treatment systems proposed at the KSM Mine will not operate seamlessly and consistently to reduce effluent concentrations to maintain baseline water quality.²⁶⁴
121. For all these reasons, Dr. Zamzow concludes that Seabridge has likely understated the threat the KSM Mine poses to the Unuk River system.²⁶⁵

122. Relying on Dr. Zamzow's findings and his own extensive experience with containment and treatment systems in other mines, Dr. Chambers concluded that the actual ranges of downstream concentrations of metals are likely to increase due to discharge from the KSM Mine, and that these increases could be substantial.²⁶⁶ As discussed below, increased concentrations of pollution in downstream waters could significantly reduce fish populations in the downstream waters that Petitioners use.²⁶⁷ For these reasons, Dr. Chambers concluded that, by granting KSM Mine's environmental permit, the British Columbia government has demonstrated that "it is willing to authorize a mine project that will, as a matter of course, use downstream salmon waters – including waters in the United States – as mixing zones to dilute toxic mine wastes (presently for selenium)."²⁶⁸

The KSM Mine significantly threatens fish populations in downstream waters

123. Seabridge's environmental assessment found that the levels of metals in the Unuk River system are naturally high even in the absence of a mine, because of metals leaching out of naturally occurring acid-generating rock.²⁶⁹ Based on a review of that assessment and the reports of Drs. Chambers and Zamzow, Sarah O'Neal, a fish biologist and researcher at the University of Washington with 20 years of experience in freshwater ecology in salmon ecosystems,²⁷⁰ concluded that water in the Unuk watershed is currently close to toxicity thresholds for fish survival, and that fish living in them have very little margin of safety.²⁷¹ As a result, an increase in concentrations of already naturally elevated selenium, aluminum, cadmium, copper, and zinc in waters downstream of an operational KSM Mine could cause population-level harms to Unuk River salmon, eulachon, and other fish, resulting in "significant and sustained population decreases."²⁷²

124. Ms. O'Neal explains that, above certain concentrations, many heavy metals are toxic to fish and other aquatic life like salmon and eulachon.²⁷³ Increased concentrations of several of the metals associated with the B.C. Mines could lead to population-level harms to the fish in the Taku, Stikine, and Unuk watersheds.²⁷⁴

Selenium

125. Unlike other metals, the toxic effects of selenium occur primarily through dietary as opposed to waterborne pathways.²⁷⁵ Unlike most trace elements, selenium bioaccumulates (accumulates in the body faster than the body can process or excrete it) and sometimes biomagnifies (becomes more highly concentrated in animal tissue at successively higher levels of the food chain).²⁷⁶ Since diet is the primary source of selenium to fish, its efficient uptake by algae and macroinvertebrates contributes to selenium toxicity.²⁷⁷ Thus, relatively low selenium concentrations can lead to fish toxicity via bioaccumulation.²⁷⁸ Although adult fish are relatively tolerant of selenium, bioaccumulation allows it to be



Jarred Unuk River salmon eggs.
Photo by Irene Dundas, courtesy of SEITC

deposited into eggs during their formation, resulting in deformations, typically in the fishes' skeleton, skull, or fins.²⁷⁹

126. As a result of all these factors, population-level effects of selenium exposure have been documented in multiple freshwater ecosystems, including multiple cases "where the majority of fish species have been extirpated as a result of selenium contamination."²⁸⁰ In the same ways, "increased selenium concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River."²⁸¹

Copper

127. Copper is "one of the most pervasive and toxic elements to aquatic life, and has been documented at levels one to three orders of magnitude greater than background in mining areas."²⁸² All aerobic organisms use copper for growth and metabolism.²⁸³ Because it is essential to biological function, copper is readily incorporated into fish tissues.²⁸⁴ Fish are "primarily exposed to copper through water in the gill, kidney, olfactory receptors, and lateral line cilia (waterborne exposure), or in the intestine (dietary exposure)."²⁸⁵
128. Olfactory inhibition resulting from copper exposure "occurs within minutes and lasts for weeks or longer, with the potential to affect all aspects of salmonid biology."²⁸⁶ Exposure can "reduce growth, immune response, reproduction, and survival."²⁸⁷ Specific examples of toxic effects "include disrupted migration; altered swimming; oxidative damage; impaired respiration; disrupted osmoregulation and pathology of kidneys, liver, gills, and other stem cells; impaired mechanoreception of lateral line canals; impaired function of olfactory organs and brain; and altered behavior, blood chemistry, enzyme activity, the endocrine system, and gene transcription and expression."²⁸⁸ These "effects have been demonstrated for juvenile and adult life stages primarily of coho and Chinook salmon and rainbow trout."²⁸⁹
129. Many sublethal effects of copper are identical to those causing mortality, and include physiological effects such as "decreased growth, swimming speed or activity, and feeding rates."²⁹⁰ Coho salmon exhibit diminished immune response after exposure to copper.²⁹¹ Reproductive performance also decreases in adult salmonids exposed to copper.²⁹² Very slight increases in copper concentrations (5-25 parts per billion) inhibit olfaction in coho and Chinook salmon and rainbow trout, with potential to inhibit recognition of predators, prey, mates, kin, and natal streams.²⁹³ Chinook salmon and rainbow trout avoid copper-contaminated waters altogether, except after long-term sublethal copper exposure, after which their avoidance response may be impaired.²⁹⁴ Avoidance can lead to degradation of spawning patterns and resulting genetic diversity that are essential to maintaining overall population structure and sustainability.²⁹⁵ Copper-contaminated streams can delay or interrupt adult spawning and downstream smolt migrations and can impair osmoregulation of smolt in seawater if impaired.²⁹⁶
130. Copper can also harm fish through indirect pathways. Numerous studies document adverse effects of copper on freshwater algae, zooplankton, mussels, and other invertebrates, which could result in reduced prey abundance and quality to support fish

growth and reproduction.²⁹⁷ Copper is one of the most toxic metals to algae, which form the base of the salmonid food chain. Algae production can decline with copper increases of only 1-2 parts per billion (ppb).²⁹⁸ Zooplankton and lotic macroinvertebrates are also extremely sensitive to copper increases.²⁹⁹

131. Copper toxicity increases in acidic conditions, soft waters (low hardness), and in waters impoverished of dissolved organic matter, all of which occur in the waters draining the KSM deposit.³⁰⁰
132. For all these reasons, Ms. O’Neal concludes that increases in copper concentrations from existing levels downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River.³⁰¹

Aluminum

133. Aluminum can be lethally toxic to fish in two ways. First, aluminum can disrupt a fish’s ionoregulatory processes, meaning it would disrupt salt and water balances across the gill and other cellular membranes.³⁰² Second, aluminum can disrupt a fish’s respiratory system, leading, at high aluminum concentrations, to clogging of gills by mucus.³⁰³ These effects lead to insufficient oxygen exchange, hyperventilation and eventually suffocation.³⁰⁴
134. Even when these impacts occur below lethal levels, they can be harmful to fish. By accumulating on the gill surface, aluminum can cause mucous production to increase by up to four times normal levels, inhibiting respiration.³⁰⁵ Stress associated with impaired respiration can inhibit the ability of salmonids to deal with additional stressors, including natural stressors like smoltification, the series of physiological changes when juvenile salmonid fish adapt from living in fresh water to living in salt water.³⁰⁶ For example, juvenile Atlantic salmon (*Salmo salar*, a species that share the *Salmonidae* family with Pacific salmon) exposed to aluminum exhibited a 20-30% reduction in survival and reduced seawater tolerance.³⁰⁷ In addition, aluminum can reduce salmonid growth rates and swimming speeds.³⁰⁸ Aluminum can also impair salmonid olfaction, which is critical to locating predators and prey, mates and kin, and homing to natal streams.³⁰⁹ Interference with “any of these processes essential to survival and successful reproduction could ultimately lead to population-level impacts, meaning significant and sustained decreases of the population’s size.”³¹⁰
135. The larval stage, when larvae emerge from gravels where their eggs incubate, may be the salmonid life stage most sensitive to aluminum.³¹¹ This is “concerning given that all six salmonid species as well as Dolly Varden and cutthroat trout (*Oncorhynchus clarkii*) incubate in the gravels around and downstream of the KSM Mine site.”³¹²
136. Aluminum can also indirectly harm fish. Aluminum has deleterious effects on freshwater zooplankton and insects known to be important food sources for salmonids.³¹³ Aluminum is also toxic to algal species that form the base of the aquatic food web and are a main diet item for many macroinvertebrate species. Consequently, deleterious

effects of aluminum pollution can reverberate throughout the food web with ultimately negative impacts on salmonid growth and survival, particularly for those species that spend time rearing in freshwater, such as Chinook, coho, and sockeye salmon, rainbow and steelhead trout, and Dolly Varden.³¹⁴

137. For all these reasons, Ms. O’Neal concludes that increased concentrations of aluminum downstream from the KSM Mine in the Unuk River could lead to population-level impacts for salmon, trout, and eulachon.³¹⁵

Cadmium

138. Exposure to cadmium in fish occurs primarily through water in the gill and kidney (waterborne exposure) or in the intestine (dietary exposure).³¹⁶ Because cadmium inhibits the uptake of calcium, which is biologically essential to fish, excess cadmium concentrations can be lethal to fish.³¹⁷
139. Sublethal physiological impacts of cadmium exposure include reduced growth and condition factor (unit weight per unit growth; an index of fish health).³¹⁸ Exposure also impairs egg development and causes premature hatching.³¹⁹ Exposure may also depress immune response, as evidenced by elevated stress chemicals in exposed salmonids.³²⁰ Cadmium also induces neurotoxic effects in fish, including hyperactivity leading to decreased growth and increased detection by predators.³²¹ Emerging fry are most sensitive in Chinook salmon, while in rainbow and steelhead trout both fry and rearing parr (young fish between the stages of fry and smolt) are equally sensitive.³²²
140. Behavioral effects of cadmium on salmonids include a diminished ability to avoid predators, possibly due to olfactory inhibition; diminished foraging success; and altered social behavior including less aggressive competition.³²³ At extremely elevated cadmium levels, salmonids have been documented avoiding waters altogether.³²⁴
141. Cadmium can also harm fish indirectly. For example, because “invertebrates (particularly amphipods) are more sensitive to chronic exposures of cadmium,”³²⁵ chronic cadmium exposure will result in fewer invertebrates for fish to feed upon.³²⁶ Its deleterious effects can reverberate throughout the food web, with ultimately negative impacts on salmonid growth and survival, particularly for those species that spend time rearing in freshwater such as Chinook, coho, and sockeye salmon, rainbow and steelhead trout, and Dolly Varden.³²⁷
142. For these reasons, Ms. O’Neal concludes that increases in concentrations of cadmium downstream of the KSM Mine could lead to population-level impacts on salmon, trout, and eulachon in the Unuk River.³²⁸

Zinc

143. Zinc is an essential element used by vertebrates in the synthesis of proteins, including hemoglobin. However, at high enough concentrations, zinc can be harmful to fish. Fish kills and/or the absence of fish (including salmonid) species are commonly associated

with elevated zinc, copper, and cadmium concentrations downstream of mining activity.³²⁹

144. Like cadmium, zinc mimics calcium, inhibiting its uptake. Such inhibition can be lethal.³³⁰ Waterborne exposure competitively inhibits calcium, binding to sites on fish gills and leading to impaired gas exchange, gill inflammation, and ultimately suffocation, or decreased survival, growth, reproduction, and hatching.³³¹ Dietary uptake poses lower risk to fish than waterborne exposure, primarily through gills.³³²
145. Increased stress and decreased immune response has been attributed to zinc exposure in rainbow trout.³³³ Juvenile rainbow trout and other salmonids have also been documented avoiding zinc-contaminated waters.³³⁴ Other effects of zinc on behavior include increased ventilation and cough rates, altered swimming patterns, and decreased growth.³³⁵
146. Zinc can harm fish indirectly as well. Invertebrates are more sensitive to zinc than fish, so decreased feeding opportunities are a likely pathway for indirect effects of zinc.³³⁶
147. Although waters naturally high in cadmium (naturally hard) can ameliorate the toxic calcium-uptake inhibitive effects of zinc, the waters draining the KSM deposit are low in cadmium.³³⁷ Dissolved organic matter can also decrease the bioavailability or overall toxicity of zinc, but levels of dissolved organic matter are also low in the waters draining the KSM Mine area.³³⁸
148. For these reasons, Ms. O’Neal concludes that increased zinc concentrations downstream of the KSM Mine could lead to population-level impacts on salmon, trout, and eulachon populations in the Unuk River.³³⁹

149. In sum, the KSM Mine creates a significant risk of a substantial increase in concentrations of metals toxic to fish in downstream waters of the Unuk River in which salmon and eulachon spawn, rear, and migrate. An increase in the already naturally elevated concentrations of any one of the metals discussed here could cause population-level harms to Unuk River salmon, eulachon, and other fish species, meaning significant and sustained population decreases. Of most concern are elevated levels of copper and selenium. Copper can harm all life stages of salmonids even at relatively low concentrations, and selenium, has not successfully been treated at other mine sites and its ultimate impact cannot be predicted because of its bioaccumulative properties.³⁴⁰ Increased concentrations in many or all of these metals – which is likely, due to the kind of mining and waste-management processes used at the B.C. Mines – would have even more serious effects, as combinations of multiple metals can have synergistic effects, meaning effects can be greater than the sum of the effects of individual metals.³⁴¹
150. Although Ms. O’Neal’s analysis focuses on the KSM Mine in the Unuk River watershed, her conclusions are relevant to the Taku and Stikine watersheds. While the proponents of the other B.C. Mines have not collected and modeled downstream baseline water-quality data for these rivers, these watersheds have “poor buffering capacity and little

ability to assimilate metals or ameliorate their effects.”³⁴² It is also possible that the Taku and Stikine rivers, like the Unuk, already feature levels of natural occurring metals close to toxicity thresholds for fish like salmon and eulachon. For these reasons, Ms. O’Neal concludes that “[i]t is not unreasonable … to expect that harm to aquatic life will be similar downstream of other mines [in the Taku and Stikine], at magnitudes relative to the size of each mine. The combined impacts of multiple mines would no doubt increase the likelihood of population-level harm in the Unuk, Stikine, and Taku Rivers.”³⁴³

5. THE B.C. MINES POSE IMMINENT, ONGOING, AND SIGNIFICANT THREATS TO PETITIONERS’ RIGHTS

151. Each of the B.C. Mines present imminent, ongoing and significant threats to Petitioners.
152. Canada and British Columbia are not prioritizing environmental health or human safety when regulating mines. As mentioned above, the government of British Columbia has for decades failed to enforce regulations against mines.³⁴⁴ Despite the recommendations of various experts to update its regulations and implement key reforms to improve compliance and enforcement, both governments continue to authorize mines to use mitigation practices that have failed to prevent the risks of operation. All six of the B.C. Mines feature infrastructure and pollution-mitigation strategies that could substantially increase metal concentrations downstream of the mines that could harm fish populations that Petitioners rely on for their cultural, spiritual and subsistence practices. Even small increases in metal concentrations downstream of the mines could harm fish populations (see discussion in section IV.B.4. above).
153. For these reasons, the currently operating Red Chris and Brucejack mines pose imminent, ongoing, and significant threats to the Petitioners. The Tulsequah Chief Mine is also an imminent and significant threat because, although currently looking for a buyer, the mine has received all necessary permits and a new buyer would be able to commence operations very rapidly, with no time for Petitioners to seek the assistance of the Commission before the mine began discharging pollution into the watershed.³⁴⁵
154. The Galore Creek, Schaft Creek and KSM mines also present imminent and significant threats to Petitioners, notwithstanding that each is still in the permitting stage. Like the Red Chris and Brucejack mines, each of these mines would use pollution treatment and containment processes that would be likely to substantially increase metal concentrations downstream of the mines.³⁴⁶
155. Several additional factors contribute to making the Galore Creek, Schaft Creek, and KSM mines imminent and substantial threats to Petitioners. To begin with, the governments of Canada and British Columbia are likely to approve these mines without adequate safeguards to prevent the likely chronic or catastrophic contamination described above, as British Columbia did in authorizing the Red Chris Mine to use the same unsafe wet tailings dam design that failed at the Mount Polley Mine only days after an expert panel recommended against using this practice. In the case of the KSM Mine, both governments approved environmental authorizations even though the proponent

acknowledged that operations would increase downstream concentrations of selenium, which is known to be harmful to fish at low concentrations.

156. Moreover, it is unlikely that the governments of Canada or British Columbia will consider threats to Petitioners as part of the permitting phase. The project proponents are not required to assess downstream water quality impacts and, with the exception of KSM Mine, have not done so. Nor, as explained in following section and section VI below, do Petitioners have adequate avenues to raise their concerns with the governments of British Columbia and Canada. In addition, these governments have not consulted with or sought Petitioners' free, prior, and informed consent about the B.C. Mines.
157. Once operational, it would also become difficult and costly to prevent the violations of Petitioners' human rights because these mining companies will have secured huge financial commitments, made costly capital expenditures, and committed to and constructed pollution control infrastructure that has been determined to be unsafe. It is also likely that these mines will begin polluting downstream waters immediately, as is the case with KSM Mine.

V. VIOLATIONS: CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' HUMAN RIGHTS

158. Pollution from the B.C. Mines could cause sustained and significant reductions in salmon and eulachon populations in the Taku, Stikine, and Unuk River watersheds, irreversibly harming Petitioners' subsistence and cultural practices, and endangering their health and property. This would threaten generations-old subsistence practices that form the backbone of Petitioners' livelihoods, culture and traditions. Tribal members would not be able to share their culture and traditions with future generations, including through teaching younger generations traditional subsistence and gift-giving practices, and the ceremonial use of traditional foods, all of which are fundamental elements of Petitioners' culture. Petitioners' livelihoods and health would suffer from the loss of an important source of healthy traditional food. They would have to buy less-nutritious food in place of the fish they traditionally harvest and eat, and would not be able to afford, or perhaps even find, the wild salmon and eulachon that are central to their subsistence, as well as to their spiritual and cultural traditions. These harms constitute violations of Petitioners' human rights to culture, means of subsistence, health, and right to use and enjoy the lands they have traditionally used and occupied. In addition, Canada's and British Columbia's failure to consult with or seek the free, prior, and informed consent of Petitioners during the approval or permitting of any of the B.C. Mines violates Petitioners' rights to prior consultation, and to free, prior, and informed consent.

A. THE AMERICAN DECLARATION SHOULD BE INTERPRETED AND APPLIED IN THE CONTEXT OF RELEVANT INTERNATIONAL NORMS AND PRINCIPLES

159. The Inter-American Court of Human Rights (Inter-American Court or Court) and the Inter-American Commission on Human Rights (Inter-American Commission or Commission) have recognized that although originally adopted as a declaration and not as a legally binding treaty, "the American Declaration is a source of international

obligations for the member states of the [Organization of American States].”³⁴⁷ In interpreting the American Declaration, both the Court and the Commission have consistently recognized the relevance of broader developments in international law. These developments should inform the Commission’s interpretation of the rights at issue in this petition: the rights to the benefits of culture; property; preservation of health and well-being; and means of subsistence, as well as special protection for the rights of indigenous peoples.

160. Additionally, these developments direct the Commission to give particular recognition to violations that result from threats to the environment upon which Petitioners’ lives and culture depend.

1. THE AMERICAN CONVENTION ON HUMAN RIGHTS BEARS ON INTERPRETATION OF THE AMERICAN DECLARATION

161. The Commission has acknowledged that the American Convention on Human Rights (American Convention or Convention) “may be considered to represent an authoritative expression” of the rights contained in the American Declaration, and is therefore properly considered in interpreting the Declaration’s provisions.³⁴⁸ The jurisprudence of the Commission and the Court interpreting the Convention’s provisions is thus also relevant in interpreting the Declaration. At the same time, the Convention should not restrict the Court’s reading of the American Declaration or other sources of human rights. As the Convention itself states, the Convention must not be interpreted as “restricting the enjoyment or exercise of any right or freedom recognized by virtue of the laws of any State Party or by virtue of another convention … or excluding or limiting the effect that the American Declaration … and other international acts of the same nature may have.”³⁴⁹

2. DEVELOPMENTS IN OTHER INTERNATIONAL HUMAN RIGHTS SYSTEMS AND INTERNATIONAL ENVIRONMENTAL LAW SHOULD BE TAKEN INTO ACCOUNT WHEN INTERPRETING AND APPLYING THE AMERICAN DECLARATION

162. The Commission has recognized that “the provisions of … the American Declaration[] should be interpreted and applied in the context of developments in the field of international human rights law,”³⁵⁰ and has often considered other international and regional human rights documents in interpreting the scope and meaning of the rights contained in the Declaration, as well as in the Charter of the Organization of American States. Other human rights instruments that are relevant to the understanding of the rights at issue in this case include, as noted above, the American Convention, the International Covenant on Civil and Political Rights (ICCPR), the International Covenant on Economic, Social and Cultural Rights (ICESCR), other international and regional human rights conventions, and the official interpretations of these instruments by human rights bodies.

163. In addition to taking into account developments in human rights, the Inter-American Court has looked to the principles, rights, and obligations of international environmental law to inform the interpretation of the American Declaration and American Convention

in cases related to environmental matters. The Court has stated that international environmental law “contribute[s] decisively” to the interpretation of the American Convention.³⁵¹ Therefore, when interpreting human rights obligations relevant to environmental protection, consideration should be given to jurisprudence and decisions from other relevant treaty systems, “as well as the resolutions, pronouncements and statements referring to the topic that have been adopted at the international level.”³⁵² For example, in its recent advisory opinion considering states’ human rights obligations arising out of transboundary environmental harm, the Court relied on the widely recognized international law obligation requiring states to prevent transboundary environmental harm.³⁵³

B. HUMAN RIGHTS OBLIGATIONS RELATED TO THE ENVIRONMENT

1. THE AMERICAN DECLARATION AND THE AMERICAN CONVENTION REQUIRE STATES TO GUARANTEE THAT ENVIRONMENTAL HARM DOES NOT VIOLATE HUMAN RIGHTS

164. The Inter-American Court and Inter-American Commission have recognized in several cases brought by indigenous peoples, and in the Court’s recent advisory opinion on human rights and the environment, that states have an obligation to guarantee that environmental harm does not violate the human rights of people, including indigenous peoples, within their jurisdiction.

165. While some international law instruments, including the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights (Protocol of San Salvador),³⁵⁴ have established the right to a healthy environment, recognition of the relationship between environmental harm and human rights does not depend on the recognition of a “right to a healthy environment.” The Inter-American Court acknowledged this in its November 2017 advisory opinion on human rights and the environment, which was one of the Court’s first opportunities to elaborate, “in an extended manner,” on the relationship between human rights and the environment, including state obligations under the American Convention related to environmental protection.³⁵⁵ Referring to many statements of international and regional human rights bodies and courts, the Court recognized the “irrefutable relationship” between the protection of the environment and the realization of human rights, and in particular the rights of indigenous peoples.³⁵⁶ Although the Court recognized that environmental damage can affect all human rights, it noted that some rights are more susceptible to environmental harm, including the rights to food and participation in cultural life.³⁵⁷

166. The Inter-American Commission has also noted that “several fundamental rights require, as a necessary precondition for their enjoyment, a minimum environmental quality, and are profoundly affected by the degradation of natural resources.”³⁵⁸ For example, the Commission has stated that the rights to life and health are threatened “where environmental contamination and degradation pose a persistent threat to human life and health.”³⁵⁹

167. In its advisory opinion on human rights and the environment, the Inter-American Court identified two international environmental law principles that are particularly relevant to interpreting the American Convention (and, through it, the American Declaration) in situations related to environmental harm: the obligation of prevention and the precautionary principle.³⁶⁰

a. *The obligation to prevent environmental harm*

168. The obligation to guarantee the rights enshrined in the American Convention implies the duty to prevent the violation of those rights.³⁶¹ This is particularly true in the context of environmental harm. As the Inter-American Court has noted, because “it is often impossible to restore the status quo that existed before the environmental damage has occurred, prevention must be the main policy regarding the protection of the environment.”³⁶² For that reason, the interpretation of the obligation of prevention in international environmental law is relevant to understanding the scope of the obligation of prevention under the Convention.³⁶³

169. The Court has explained that the obligation of prevention under the Convention requires states to use “all means at their disposal in order to prevent the activities that are carried out under their jurisdiction from causing significant damage to the environment.”³⁶⁴ This includes regulating activities that may cause significant environmental harm; supervising and inspecting activities that may cause significant environmental harm; and carrying out and approving environmental impact studies, which among other things, respect and take into account the traditions and culture of indigenous peoples.³⁶⁵ As discussed in section V.B.2 below, states must take these steps whether the damage takes place *inside or outside of their territories*.³⁶⁶

170. Like the Court, the Inter-American Commission has explained that “[s]evere environmental pollution may ... give rise to an obligation on the part of a state to take reasonable measures to prevent” the associated risks to human rights, including through effectively regulating potentially harmful activities and carrying out and approving environmental impacts studies that consider potential harms to the traditions and culture of indigenous peoples.³⁶⁷ Addressing development activities, the Commission underscored states’ obligation to require “appropriate and effective measures to ensure that they do not proceed at the expense of the fundamental rights of persons who may be particularly and negatively affected, including indigenous communities and the environment upon which they depend for their physical, cultural and spiritual well-being.”³⁶⁸

b. *The obligation to apply the precautionary principle*

171. The precautionary principle is the legal expression of the common-sense approach that is it “better to be safe than sorry.” The Inter-American Court has interpreted this principle to mean that when there “are plausible indicators that an activity could cause serious and irreversible harms to the environment ... states must act with due caution to prevent possible harm.”³⁶⁹ This is true “even in the absence of scientific certainty” concerning the nature or likelihood of the harm.³⁷⁰

172. Canada's acceptance of this principle is reflected in its *Environmental Protection Act*, 1999, which affirms "the Government of Canada is committed to implementing the precautionary principle"³⁷¹ and requires the government to "exercise its powers in a manner that protects the environment and human health, [and] applies the precautionary principle."³⁷² Canadian case law also affirms the principle,³⁷³ as do several multilateral treaties to which Canada is party.³⁷⁴

2. STATES ARE RESPONSIBLE FOR ACTS AND OMISSIONS WITHIN THEIR TERRITORIES THAT CAUSE ENVIRONMENTAL-RELATED HUMAN RIGHTS VIOLATIONS OUTSIDE THEIR TERRITORIES

173. The American Declaration contains no territorial limitation that would insulate Canada from responsibility for its acts or omissions that violate the human rights of Alaska-based petitioners. To the contrary, in adopting the Declaration, the members of the OAS acknowledged that "the essential rights of [a person] are not derived from the fact that [they are] a national of a certain state, but are based upon attributes of [their] human personality" and that "[t]he *international protection* of the rights of [humans] should be the principal guide of an evolving American law."³⁷⁵ Where the Declaration does recognize limits on rights, it says nothing about territorial limits.³⁷⁶

174. The American Convention on Human Rights, like some other international human rights instruments,³⁷⁷ contains language that limits a state's human rights obligations to people subject to its "jurisdiction." Article 1.1 of the American Convention places on states the obligation "to respect the rights and freedoms recognized [in the Convention] and to ensure to all persons subject to their jurisdiction the free and full exercise of those rights and freedoms."³⁷⁸ However, in its November 2017 advisory opinion on human rights and the environment, the Inter-American Court makes clear that this provision does not shield states from responsibility for acts or omissions within their territories that cause environment-related human rights violations outside their territories:

The exercise of jurisdiction by the State of origin in cases of transboundary harm is based on the understanding that it is the State in whose territory or under whose jurisdiction these activities are carried out that has effective control over polluting activities and is in a position to prevent the cause of the transboundary harm which affects the enjoyment of human rights of individuals outside its territory.³⁷⁹

175. For this reason, "States are obliged to take all measures necessary to prevent activities carried out in their territory or under their control from affecting the rights of people inside or outside their territory."³⁸⁰ As explained in paragraph 169 above, this requires states to act with due diligence when assessing potentially harmful projects, including through reviewing environmental impact studies that, among other things, respect and take into account harm to the traditions and culture of indigenous peoples.³⁸¹

176. The Court's understanding of jurisdiction is consistent with recent jurisprudence of international human rights bodies that monitor compliance with treaties that have similar

“jurisdictional” language as the American Convention. Moreover, they have done so specifically in the context of claims arising out of the actions of Canadian companies, including Canadian mining companies. For example, the United Nations Human Rights Committee has applied a similar interpretation of the term “jurisdiction” in Article 2(1) of the ICCPR. In its 2015 Concluding Observations for the sixth periodic report of Canada, the Committee made several recommendations related to alleged human rights violations by Canadian companies operating outside of Canada, including that Canada should:

- (a) enhance the effectiveness of existing mechanisms to ensure that all Canadian corporations under its jurisdiction, in particular mining corporations, respect human rights standards when operating abroad;
- (b) consider establishing an independent mechanism with powers to investigate human rights abuses by such corporations abroad; and
- (c) develop a legal framework that affords legal remedies to people who have been victims of activities of such corporations operating abroad.³⁸²

177. Given the Committee’s assumption that the ICCPR’s jurisdictional limitation did not prevent Canada from having obligations concerning extra-territorial harm caused by actions taken by Canadian corporations acting *outside* Canada, it follows that Canada would also have an obligation concerning extra-territorial harm caused by its own acts or omissions taken *within* Canada.
178. The United Nations Committee on the Elimination of Racial Discrimination (CERD) has also interpreted “jurisdiction” broadly, recommending to multiple state parties that they regulate the extra-territorial activities of their corporations that interfere with the enjoyment of the rights of indigenous peoples outside their territories.³⁸³ In its Concluding Observations on Canada, for example, the Committee encouraged Canada to take appropriate legislative or administrative measures to prevent acts of transnational corporations registered in Canada which negatively impact on the enjoyment of rights of indigenous peoples in territories outside Canada. In particular, the Committee recommends that [Canada] explore ways to hold transnational corporations registered in Canada accountable. The Committee requests [Canada] to include in its next periodic report information on the effects of activities of transnational corporations registered in Canada on indigenous peoples abroad and on any measures taken in this regard.³⁸⁴
179. The Committee also recently called upon the United Kingdom “to take appropriate legislative and administrative measures to ensure that acts of transnational corporations registered in the [United Kingdom] comply with the provisions of the Convention.”³⁸⁵

180. In this case, Canada and British Columbia have authorized, or are in the process of authorizing, mines that pose a substantial risk of imminently, significantly and irreversibly violating the Petitioners' human rights through the pollution of the three transboundary watersheds they rely on for their means of subsistence, cultural practices, health, and property rights. Canada is thus exercising "effective control over polluting activities"³⁸⁶ and is in a position to prevent the transboundary harm at issue in this case. As such, Canada cannot shield itself from legal responsibility in this case, even if Petitioners live outside its territory.

3. THE HUMAN RIGHTS THAT ARE IMPLICATED BY THE ENVIRONMENTAL HARM FROM THE B.C. MINES ARE LINKED AND INTERDEPENDENT

181. As mentioned above, the Inter-American Court and Commission have recognized that damage to the environment often violates multiple rights concurrently.³⁸⁷ In particular, the Court has repeatedly recognized an interdependence of rights in cases brought by indigenous peoples, including violations of the rights to culture, life, and means of subsistence.³⁸⁸ In its 1997 report on the human rights situation in Ecuador, the Commission acknowledged that "indigenous peoples maintain special ties with their traditional lands, and a close dependence upon the natural resources provided therein – respect for which is essential to their physical and cultural survival."³⁸⁹ In its 2015 report on indigenous peoples' rights and extractive industries, the Commission observed that "damage to these lands 'invariably leads to serious loss of life and health and damage to the cultural integrity of indigenous peoples,'" and that "a range of human rights ... are frequently impacted by the implementation of extractive and development projects, including the rights to life, to physical integrity, to health, to nondiscrimination, to consultation, [to] consent and to cultural identity, information and participation, among others."³⁹⁰

182. For the tribes that live in and around the transboundary watersheds of Southeast Alaska, the relationship among land, subsistence, and culture links multiple human rights. For instance, given that many individual tribal members in Southeast Alaska rely on the watersheds for their livelihood, environmental degradation to their rivers and land in many instances violate their right to their own means of subsistence. Because a large proportion of Petitioners' diets depend on subsistence fishing, impacts on their right to their own means of subsistence would affect their right to health. In addition, for Petitioners, the fish they depend on and the practices involved in the harvest and preparation of these fish hold cultural significance and are a means of continuing key cultural traditions. Damage to the watersheds from the B.C. Mines would affect multiple human rights of Petitioners.

4. PETITIONERS' CLAIMS SHOULD BE INTERPRETED IN THE CONTEXT OF THE UNIQUE RELATIONSHIP BETWEEN INDIGENOUS PEOPLES AND THEIR LAND AND ENVIRONMENT

183. In applying the rights contained in the American Declaration to indigenous peoples, both the Inter-American Court and Commission have repeatedly,³⁹¹ and for decades,³⁹² emphasized the need to take into account the unique context of indigenous culture and

history.³⁹³ This is especially true with respect to the unique ties many indigenous peoples have to their environment. The Inter-American system,³⁹⁴ as well as customary international law, both recognize and protect these ties.³⁹⁵

184. As the Inter-American Court has recognized in numerous cases, indigenous culture

directly relates to a specific way of being, seeing, and acting in the world, developed on the basis of [indigenous peoples'] close relationship with their traditional territories and the resources therein, not only because they are their main means of subsistence, but also because they are part of their worldview, their religiosity, and therefore, of their cultural identity.³⁹⁶

As a result, “members of indigenous and tribal communities require special measures that guarantee the full exercise of their rights … in order to safeguard their physical and cultural survival.”³⁹⁷ Land has “special meaning … for … indigenous peoples, including [for] the preservation of their cultural identity and its transmission to future generations.”³⁹⁸

185. In addition, Article XIX(1) of the American Declaration on the Rights of Indigenous Peoples explicitly guarantees indigenous peoples the right to environmental protection, linking it to their right to life, spirituality, and world-view: “Indigenous peoples have the right to live in harmony with nature and to a healthy, safe, and sustainable environment, essential conditions for the full enjoyment of the right to life, to their spirituality, worldview and to collective well-being.”³⁹⁹ Article XIX(3) of the Declaration further provides: “Indigenous peoples are entitled to be protected against the introduction of, abandonment, dispersion, transit, indiscriminate use or deposit of any harmful substance that could negatively affect indigenous communities, lands, territories and resources.”⁴⁰⁰

C. CANADA’S AND BRITISH COLUMBIA’S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS’ HUMAN RIGHTS

186. The extraction of natural resources in Canada threatens the rights of indigenous peoples. As former UN Special Rapporteur on the rights of Indigenous Peoples, James Anaya, noted on his 2013 visit to Canada:

One of the most dramatic contradictions indigenous peoples in Canada face is that so many live in abysmal conditions on traditional territories that are full of valuable and plentiful natural resources. These resources are in many cases targeted for extraction and development by non-indigenous interests. While indigenous peoples potentially have much to gain from resource development within their territories, they also face the highest risks to their health, economy, and cultural identity from any associated environmental degradation. Perhaps more importantly, indigenous nations’ efforts to protect their long-term interests in lands and resources often fit uneasily into the efforts by private non-

indigenous companies, with the backing of the federal and provincial governments, to move forward with natural resource projects.⁴⁰¹

187. As described above, risks like these are abundantly present in the context of the extraction of hard-rock minerals at the B.C. Mines. Approvals of these mines violate Petitioners' rights to the benefits of their culture, their own means of subsistence, preservation of health and well-being, and right to use and enjoy the lands they have traditionally occupied.

1. CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' RIGHT TO ENJOY THE BENEFITS OF THEIR OWN CULTURE

188. The American Declaration and other sources of international law guarantee Petitioners' human right to enjoy the benefits of their culture. Given the close ties between indigenous peoples' right to culture and the condition of their lands and environment, Canada has a duty not to authorize or allow activities that degrade the transboundary watersheds in a way that infringes upon Petitioners' human right to culture.

a. *The American Declaration guarantees Petitioners' right to enjoy the benefits of their culture*

189. The American Declaration guarantees all people the right to the enjoyment of their culture.⁴⁰²

190. A number of other international instruments are relevant to the interpretation of this right. The Additional Protocol to the American Convention recognizes "the right of everyone ... [t]o take part in the cultural and artistic life of the community."⁴⁰³ Other international law instruments like the Universal Declaration of Human Rights,⁴⁰⁴ ICCPR,⁴⁰⁵ ICERD,⁴⁰⁶ and ICESCR⁴⁰⁷ also provide for cultural rights.

191. The Inter-American system recognizes that the right to culture has particular importance for indigenous peoples. Pursuant to the American Declaration on the Rights of Indigenous Peoples,

Indigenous peoples have the right to their own cultural identity and integrity and to their cultural heritage, both tangible and intangible, including historic and ancestral heritage; and to the protection, preservation, maintenance, and development of that cultural heritage for their collective continuity and that of their members and so as to transmit that heritage to future generations.⁴⁰⁸

192. For indigenous communities like Petitioners and other Southeast Alaskan Native communities, the right to culture is inextricably linked to survival. In *Case of the Mayagna (Sumo) Awas Tingni Community*, the Inter-American Court has emphasized the importance of this connection:

[T]he close ties of indigenous people with the land must be recognized and understood as the fundamental basis of their cultures, their spiritual life, their integrity, and their economic survival. For indigenous communities, relations to the land are not merely a matter of possession and production but a material and spiritual element which they must fully enjoy, even to preserve their cultural legacy and transmit it to future generations.⁴⁰⁹

193. The Court has further recognized that interference with indigenous lands necessarily implicates the right to culture.⁴¹⁰ In *Moiwana v. Suriname*, the Court recognized that the Moiwana community’s “connection to its traditional land is of vital spiritual, cultural and material importance” and that “for the culture to preserve its very identity and integrity, the Moiwana community members must maintain a fluid and multidimensional relationship with their ancestral lands.”⁴¹¹
194. More specifically, in *Yakye Axa v. Paraguay*, the Court explained that for indigenous peoples, “the land is closely linked to their oral expressions and traditions, their customs and languages, their arts and rituals, their knowledge and practices in connection with nature, culinary art, customary law, dress, philosophy, and values.”⁴¹² In *Sawhoyamaxa v. Paraguay*, the Court added that the special relationship between indigenous or tribal peoples and their lands can be seen in “traditional spiritual or ceremonial use or presence; settlements or sporadic cultivation; seasonal or nomadic hunting, fishing or gathering; the use of natural resources connected to their customs; and any other factor characteristic of their culture.”⁴¹³ In *Saramaka v. Suriname*,⁴¹⁴ the Court followed its growing number of decisions recognizing the “special relationship that members of indigenous and tribal peoples have with their territory,” which “require[s] special measures under international human rights law in order to guarantee their physical and cultural survival.”⁴¹⁵ In 2010, in *Chitay Nech v. Guatemala*, the Court stated that recognition of the “crucial” connection between indigenous groups and their territory “for their cultural structures and their ethnic and material survival” is part of the Court’s “constant jurisprudence on indigenous matters.”⁴¹⁶
195. Like the Court, the Commission has acknowledged that indigenous peoples’ lands are essential to their culture.⁴¹⁷ For instance, in *Maya Indigenous Communities of the Toledo District v. Belize (Belize Maya)*, the Commission recognized that the concept of family and religion within the context of indigenous communities, including the Maya people, is intimately connected with their traditional land, where ancestral burial grounds, places of religious significance and kinship patterns are linked with the occupation and use of their physical territories.⁴¹⁸ Recounting the Inter-American human rights system’s jurisprudence on indigenous peoples’ land-related rights, the Commission stated that the “special relationship [between indigenous and tribal peoples and their territories] is fundamental ... for the cultural integrity of indigenous and tribal peoples.”⁴¹⁹ This “internationally protected special relationship ... [is] a cultural bond of collective memory and awareness of their rights of access or ownership, in accordance with their own cultural and spiritual rules.”⁴²⁰ Specifically, the Commission stated that “[t]he right to culture includes distinctive forms and modalities of using territories such as traditional fishing, hunting and gathering as essential elements of indigenous culture.”⁴²¹ In its

reports, the Commission has further recognized the close connection between the environment and the right to culture.⁴²²

196. The American Declaration on the Rights of Indigenous Peoples also recognizes that “Indigenous peoples have the right to maintain and strengthen their distinctive spiritual, cultural, and material relationship to their lands, territories, and resources and to assume their responsibilities to preserve them for themselves and for future generations.”⁴²³ The declaration guarantees indigenous peoples

the right to their own cultural identity and integrity and to their cultural heritage, both tangible and intangible, including historic and ancestral heritage; and to the protection, preservation, maintenance, and development of that cultural heritage for their collective continuity and that of their members and so as to transmit that heritage to future generations.⁴²⁴

197. Other international human rights bodies have recognized the special relationship that indigenous peoples have with their land and its connection to their right to culture.⁴²⁵ For instance, the UN Human Rights Committee acknowledged the importance of natural resources to the right to the benefits of culture in *Bernard Ominayak and the Lubicon Lake Band v. Canada*. In that case, which the Inter-American Commission cited with approval in the *Belize Maya* decision,⁴²⁶ the petitioners alleged that the government of the province of Alberta had deprived the Band of their means of subsistence and their right to self-determination by selling oil and gas concessions on their lands.⁴²⁷ The Human Rights Committee characterized the claim as being based on the right to enjoy culture under Article 27 of the ICCPR.⁴²⁸ It found that oil and gas exploitation, in conjunction with historic inequities, threatened the way of life and culture of the Band and that Canada had thus violated Article 27.⁴²⁹

198. The UN Human Rights Committee has explained that degradation of natural resources may violate the ICCPR’s right to enjoy culture:

[C]ulture manifests itself in many forms, including a particular way of life associated with the use of land resources, especially in the case of indigenous peoples. That right may include such traditional activities as fishing or hunting and the right to live in reserves protected by law. The enjoyment of those rights may require positive legal measures of protection and measures to ensure the effective participation of members of minority communities in decisions which affect them.... The protection of these rights is directed towards ensuring the survival and continued development of the cultural, religious and social identity of the minorities concerned, thus enriching the fabric of society as a whole.⁴³⁰

199. In a subsequent case, *Länsman v. Finland*, which involved the effects of a stone quarry on an Arctic indigenous group’s reindeer-herding activities, the Human Rights

Committee confirmed that the right to culture in Article 27 of the ICCPR encompasses modern-day adaptations:

The right to enjoy one's culture cannot be determined *in abstracto* but has to be placed in context. In this connection, the Committee observes that article 27 does not only protect *traditional* means of livelihood of national minorities, as indicated in the State party's submission. Therefore, that the [indigenous petitioners] may have adapted their methods of reindeer herding over the years and practice it with the help of modern technology does not prevent them from invoking article 27 of the Covenant.⁴³¹

200. In addition, the UN Committee on Economic and Social Rights in 2009 recognized that “[i]ndigenous peoples’ cultural values and rights associated with their ancestral lands and their relationship with nature should be regarded with respect and protected, in order to prevent the degradation of their particular way of life, including their means of subsistence, the loss of their natural resources and, ultimately, their cultural identity.”⁴³²
201. Finally, the UN Declaration on the Rights of Indigenous Peoples specifically guarantees the cultural rights of indigenous groups and links them to the natural environment. The Declaration states that

[i]ndigenous peoples have the collective and individual right to ... prevention of and redress for ... [a]ny action which has the aim or effect of depriving them of their integrity as distinct peoples, or of their cultural values or ethnic identities; ... [and a]ny action which has the aim or effect of dispossessing them of their lands, territories or resources.⁴³³

As part of the right to the benefits of culture, the Declaration also includes the right to “revitalize, use, develop and transmit to future generations [indigenous peoples’] histories, languages, oral traditions, philosophies, writing systems and literatures, and to designate and retain their own names for communities, places and persons.”⁴³⁴

- b. *Pollution from the B.C. Mines would violate Petitioners' right to enjoy the benefits of their culture*
202. Canada and British Columbia have authorized three of the six B.C. Mines, granted environmental authorizations to a fourth (the KSM Mine), and will likely authorize the others. Each of these mines will likely release toxic acid mine drainage that could substantially harm fish populations in the watersheds used by Petitioners. In addition, a catastrophic tailings dam breach, a serious risk due to Canada’s and British Columbia’s approvals of poor designs, could also significantly damage the downstream watersheds and their fish populations. Such pollution could have dire consequences for salmon and eulachon populations that Petitioners rely on as an important food source.
203. Chronic acid mine drainage from the B.C. Mines, as well as the high risk of catastrophic pollution events, could cause sustained and significant reductions in salmon and eulachon

populations in the watersheds in which Petitioners harvest these fish. Such fish population declines would undermine Petitioners' ability to engage in cultural and spiritual practices related to the harvest and sharing of these fish.

204. As discussed above,⁴³⁵ salmon and eulachon harvests allow Petitioners to engage in communal gift-giving, sharing of stories, inter-tribal exchanges and bonding with their own tribes, practices they have passed on for generations, if not millennia. Fish products also feature prominently in sacred rituals, such as ceremonies commemorating ancestors or the death of community members. For example, the Taku River and its bountiful harvests are sacred to the Douglas Indian Association, and fishing from it has spiritual importance that reinforces bonds with past generations. Petitioners also use fishing to teach younger generations about their traditions, history, and language, and fishing is a key component of maintaining and protecting their cultural identities.
205. Damage to the environment from the B.C. Mines would permanently undermine Petitioners' ability to engage in these practices. Like the indigenous petitioners in numerous cases before the Inter-American Court, Petitioners' culture directly relates to a specific way of being, seeing, and acting in the world, developed on the basis of their close relationship with their traditional territories and the resources therein, not only because they are their main means of subsistence, but also because they are part of their worldview, their religiosity, and therefore, of their cultural identity.⁴³⁶

By virtue of the “special relationship that members of indigenous and tribal peoples have with their territory,” Petitioners merit “special measures under international human rights law in order to guarantee their physical and cultural survival.”⁴³⁷

206. Through its approvals of the mines and its failure to adequately regulate and prevent the threats they pose, Canada has thus failed to take necessary and precautionary measures to guarantee Petitioners' right to the benefits of their culture provided for in Article XIII of the American Declaration.
 2. CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' RIGHT TO THEIR OWN MEANS OF SUBSISTENCE AS A COMPONENT OF THEIR RIGHTS TO CULTURE, LIFE, HEALTH, AND PROPERTY
207. Indigenous peoples' right to their own means of subsistence is recognized in the Inter-American system's jurisprudence and under international law. Canada thus has a duty not to allow or authorize activities that degrade the transboundary watersheds such that it violates Petitioners' right to their own means of subsistence.
 - a. *The American Declaration guarantees Petitioners' right to their own means of subsistence*

208. The ICESCR and ICCPR both provide that “[i]n no case may a people be deprived of its own means of subsistence.”⁴³⁸ In the context of indigenous peoples, the right to one's

own means of subsistence has become a recognized principle of international human rights law. Article XIX of the American Declaration on the Rights of Indigenous Peoples recognizes that indigenous peoples have the “right to be guaranteed the enjoyment of their own means of subsistence,” and “have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources.”⁴³⁹ The UNDRIP provides that indigenous peoples have the right “to be secure in the enjoyment of their own means of subsistence and development.”⁴⁴⁰

209. For people who depend on natural resources for their livelihood, the right to their own means of subsistence is inherent in, and a necessary component of, the American Declaration’s rights to property, health, life, and culture. The Inter-American Court has recognized that indigenous peoples’ close relationship with their traditional lands and natural resources stems in part from the fact that “these are their main means of subsistence.”⁴⁴¹ In *Xákmok*, the Court recognized that the Xákmok community’s connection to its traditional lands is “indissoluble and fundamental for … its food supply,” and that displacement from their traditional lands by private land owners made hunting, fishing, and gathering “constantly more difficult to the point that the indigenous people decid[ed] to leave the [traditional land] and relocate … in other places, thus separating part of the Community.”⁴⁴² The Court found that this displacement had interfered with the Xákmok’s means of subsistence and thus had violated their right to life.⁴⁴³
210. The Commission has also recognized that indigenous peoples’ “special relationship [to their territories] is fundamental … for the[ir] material subsistence,”⁴⁴⁴ and that such subsistence is related to the right to life. In *Yakye Axa*, the Court found that Paraguay’s failure to legally recognize and protect traditional lands of indigenous peoples “has had a negative effect on the right of the … [Yakye Axa] Community to a decent life, because it has deprived them of the possibility of access to their traditional means of subsistence.”⁴⁴⁵ The Court found that displacement of the Yakye Axa from their traditional lands “caused special and grave difficulties to obtain[ing] food, primarily because the area where their temporary settlement is located does not have appropriate conditions for cultivation or to practice their traditional subsistence activities, such as hunting, fishing, and gathering.”⁴⁴⁶
211. The American Declaration on the Rights of Indigenous Peoples recognizes the potential adverse impacts to indigenous peoples’ means of subsistence from development projects, declaring that they have the right to restitution or compensation when their means of subsistence are deprived:

Indigenous peoples who have been deprived of their own means of subsistence and development have the right to restitution and, where this is not possible, to fair and equitable compensation. This includes the right to compensation for any damage caused to them by the implementation of state, international financial institutions or private business plans, programs, or projects.⁴⁴⁷

b. *Pollution from the B.C. Mines would violate Petitioners' right to their own means of subsistence*

212. Canada and British Columbia have authorized three of the six B.C. Mines, granted environmental authorizations to a fourth (the KSM Mine), and will likely authorize the others. Each of these mines will likely release toxic acid mine drainage that could substantially harm fish populations in the watersheds used by Petitioners. In addition, a catastrophic tailings dam breach, a serious risk due to Canada's and British Columbia's approvals of poor designs, could also significantly damage the downstream watersheds and their fish populations. Such pollution could have dire consequences for salmon and eulachon populations that Petitioners rely on as an important food source.

213. As described above,⁴⁴⁸ subsistence fishing is a primary source of food and livelihood among Southeast Alaskan Native peoples, including Petitioners, and has been for generations. Like other indigenous peoples, Petitioners' "special relationship [to their territories] is fundamental ... for the[ir] material subsistence."⁴⁴⁹

214. Smoked, frozen, or canned salmon and eulachon provide a year-round source of nutritious food for which substitutes are unavailable to or too expensive for Petitioners.

215. Through its approvals of the mines and its failures to adequately regulate and prevent the threats they pose, Canada has thus failed to take necessary and precautionary measures to guarantee Petitioners' right to their own means of subsistence provided for in Articles I, XI, XIII, and XXIII of the American Declaration.



Canned smoked salmon. Photo by Carrie Dodson, courtesy of SEITC

3. CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' RIGHT TO THE PRESERVATION OF HEALTH

a. *The American Declaration guarantees Petitioners' right to the preservation of health*

216. The American Declaration provides that "[e]very person has the right to the preservation of his health through sanitary and social measures relating to food, clothing, housing and medical care, to the extent permitted by public and community resources."⁴⁵⁰ The meaning of this guarantee is informed by the Protocol of San Salvador, which ensures "the enjoyment of the highest level of physical, mental and social well-being."⁴⁵¹ Other major international human rights instruments safeguard the right to health, including the Universal Declaration of Human Rights,⁴⁵² ICESCR,⁴⁵³ and the African Charter on Human and Peoples' Rights.⁴⁵⁴ Further supporting the universal and fundamental nature

of this right, at least 115 national constitutions recognize the right to health or health care.⁴⁵⁵

217. The Inter-American system has long recognized the close relationship between environmental degradation and the right to health of indigenous peoples. For example, the American Declaration on the Rights of Indigenous Peoples recognizes that “[i]ndigenous peoples have the collective and individual right to the enjoyment of the highest attainable standard of physical, mental, and spiritual health.”⁴⁵⁶
218. In *Yanomami v. Brazil*, the Commission held that the government of Brazil violated the Yanomami people’s right to health by failing to prevent environmental degradation arising from road construction and the subsequent development of Yanomami indigenous lands, which caused an influx of pollutants and resulted in widespread disease and death.⁴⁵⁷ The Commission found that the government’s failure to take timely and effective measures to prevent these developments had violated the Yanomami people’s right to the preservation of health and well-being.⁴⁵⁸
219. In *Belize Maya*, the Commission recognized the particular impacts that environmental harm can have on indigenous peoples’ right to health and well-being, finding that the Maya people’s rights were so dependent on the integrity and condition of indigenous land that “broad violations” of indigenous property rights necessarily infringed upon their health and well-being.⁴⁵⁹ In its 1997 Report on the Situation of Human Rights in Ecuador, the Commission observed that “damage to [traditional] lands ‘invariably leads to serious loss of life and health … of indigenous peoples.’”⁴⁶⁰ In that report, the Commission became the first authoritative international institution to recognize that human rights are implicated “where environmental contamination and degradation pose a persistent threat to human life and health,” and that governments have a responsibility to protect human rights by preventing such degradation.⁴⁶¹
220. Like the Commission, other international human rights bodies and experts have recognized the close relationship between environmental protection and health. For instance, the UN Committee on Economic and Social Rights has explained that the right to “the highest attainable standard of physical and mental health” in Article 12 of the ICESCR “extends to the underlying determinants of health, such as … a healthy environment.”⁴⁶² The committee has further stated that victims of a violation of the right to health should have access to remedies at both national and international levels and should be entitled to adequate reparation.⁴⁶³
 - b. *Pollution from the B.C. Mines would violate Petitioners’ right to the preservation of health*
221. Canada and British Columbia have authorized three of the six B.C. Mines, granted environmental authorizations to a fourth (the KSM Mine), and will likely authorize the others. Each of these mines will likely release toxic acid mine drainage that could substantially harm fish populations in the watersheds used by Petitioners. In addition, a catastrophic tailings dam breach, a serious risk due to Canada’s and British Columbia’s approvals of poor designs, could also significantly damage the downstream watersheds

and their fish populations. Such pollution could have dire consequences for salmon and eulachon populations that Petitioners rely on as an important food source.

222. As explained above,⁴⁶⁴ when deprived of this food source, Petitioners will be forced to shift their diet to more expensive, less nutritious store-bought food. However, because Southeast Alaskan Native families generally have low incomes, often less than US \$20,000 per annum, they may not be able to afford fish and other healthy similarly nutritious food in the cash economy (see section IV.A.2), and for some Petitioners who live in remote locations, store-bought alternatives are often unavailable. This is likely to lead to adverse health effects.⁴⁶⁵
223. Through its approvals of the mines and its failures to adequately regulate and prevent the threats they pose, Canada has thus failed to take necessary and precautionary measures to guarantee Petitioners' right to the preservation of their health guaranteed in Article XI of the American Declaration.
 4. CANADA'S AND BRITISH COLUMBIA'S APPROVALS OF THE B.C. MINES VIOLATE PETITIONERS' RIGHT TO USE AND ENJOY THE LANDS THEY HAVE TRADITIONALLY USED AND OCCUPIED
 - a. *The American Declaration guarantees Petitioners' right to use and enjoy the lands they have traditionally occupied*
224. The American Declaration guarantees Petitioners' right to "own such private property as meets the essential needs of decent living and helps to maintain the dignity of the individual and of the home."⁴⁶⁶ Similarly, the American Convention declares that "[e]veryone has the right to the use and enjoyment of his property."⁴⁶⁷ The Commission acknowledged the fundamental nature of the right to property when it stated that "[v]arious international human rights instruments, both universal and regional in nature, have recognized the right to property as featuring among the fundamental rights" of humans.⁴⁶⁸ Such instruments include the Universal Declaration of Human Rights,⁴⁶⁹ the European Convention on Human Rights,⁴⁷⁰ and the African Charter on Human and Peoples' Rights.⁴⁷¹
225. The Inter-American system has long recognized that indigenous peoples have a fundamental human right to use and enjoy the lands they have traditionally occupied, independent of domestic title. For example, the American Declaration on the Rights of Indigenous Peoples provides that indigenous peoples have "the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired."⁴⁷² The Declaration also guarantees indigenous peoples' right "to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired."⁴⁷³
226. In *Awas Tingni*, the Inter-American Court held that the government of Nicaragua had violated the Awas Tingni's rights to property and judicial protection when it granted concessions to a foreign company to log on Awas Tingni's traditional lands without

consulting them or getting their consent. The Court explained that “the close relationship that the communities have with the land must be recognized and understood as a foundation for their cultures, spiritual life, cultural integrity, and economic survival.”⁴⁷⁴ The Court further noted that, “[f]or indigenous communities, relations to the land are not merely a matter of possession and production but a material and spiritual element which they must fully enjoy, even to preserve their cultural legacy and transmit it to future generations.”⁴⁷⁵

227. In the *Saramaka* case, the Court recognized that the “inextricable connection members of indigenous and tribal peoples have with their territory” requires states to “ensure the security and permanence of their control and use of the natural resources, which in turn maintains their way of life.”⁴⁷⁶ The Court held that “[t]his connectedness between the territory and the natural resources necessary for [indigenous peoples’] physical and cultural survival is precisely what needs to be protected under Article 21 of the Convention in order to guarantee the members of indigenous and tribal communities’ right to the use and enjoyment of their property.”⁴⁷⁷
228. The Court has also recognized that environmental degradation – whether caused by a state’s actions or inactions – can violate the human right to property and give rise to an obligation on a state to take positive measures to ensure that third parties do not infringe upon property rights, especially those of indigenous people.⁴⁷⁸ For example, in *Saramaka*, the Court found that logging concessions issued by Suriname in traditional Saramaka lands “damaged the environment and the deterioration … had a negative impact on lands and natural resources traditionally used by members of the Saramaka people.”⁴⁷⁹ The Court held that Suriname violated the Saramaka people’s right to property by “fail[ing] to put in place adequate safeguards and mechanisms in order to ensure that [state-issued] logging concessions would not cause major damage to Saramaka territory and communities,” and “did not allow for the effective participation of the Saramakas in the decision-making process regarding these logging concessions, in conformity with their traditions and customs.”⁴⁸⁰
229. The Inter-American Commission has also recognized the right of indigenous peoples to use and enjoy their traditional lands, regardless of whether these lands have been formally recognized by law. In *Belize Maya*, the Commission held that Belize violated the Maya people’s right to use and enjoy their property by granting concessions to third parties to exploit resources that degraded the environment within lands traditionally used and occupied by the Maya.⁴⁸¹ The Commission noted that indigenous people’s international human right to property is based in international law and does not depend on domestic recognition of property interests.⁴⁸² Indigenous property rights are broad, and are not limited “exclusively by entitlements within a state’s formal legal regime, but also include that indigenous communal property that arises from and is grounded in indigenous custom and tradition.”⁴⁸³
230. Other sources of international law also recognize the special significance of traditional lands to people who rely on their land for culture, well-being, or subsistence. For instance, the European Court of Human Rights (European Court), in *Dogan v. Turkey*, held that the petitioners had “unchallenged rights over the common [ancestral] lands in

the village, such as the pasture, grazing and the forest land” from which their livelihood depended, adding that the resulting economic resources and revenue may qualify as part of the right to property under the European human rights system.⁴⁸⁴ The European Court acknowledged that environmental harm to those lands could result in a breach of that right from either existing or future claims in which a petitioner “can argue that he has at least a reasonable and ‘legitimate expectation’ of obtaining effective enjoyment of a property right.”⁴⁸⁵

231. The UN Declaration on the Rights of Indigenous Peoples specifically includes “the right to own, use, develop and control the lands, territories, and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired,”⁴⁸⁶ along with “the right to maintain and strengthen their distinctive spiritual relationship with … [those] lands … and … resources and to uphold their responsibilities to future generations in this regard.”⁴⁸⁷ That declaration also recognizes indigenous peoples’ “right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources” and requires that states “give legal recognition and protection to these lands, territories and resources.”⁴⁸⁸
 - b. *Pollution from the B.C. Mines would violate Petitioners’ right to use and enjoy the lands they have traditionally occupied*
232. Canada and British Columbia have authorized three of the six B.C. Mines, granted environmental authorizations to a fourth (the KSM Mine), and will likely authorize the others. Each of these mines will likely release toxic acid mine drainage that could substantially harm fish populations in the watersheds used by Petitioners. In addition, a catastrophic tailings dam breach, a serious risk due to Canada’s and British Columbia’s approvals of poor designs, could also significantly damage the downstream watersheds and their fish populations. Such pollution could have dire consequences for salmon and eulachon populations that Petitioners rely on as an important food source.
233. Petitioners have fished in the three watersheds affected by the B.C. Mines for millennia. These watersheds and the fish they harvest from them are a vital “foundation for their culture, spiritual life, cultural integrity, and economic survival.”⁴⁸⁹ Due to their connection to their traditional lands and the watersheds, Petitioners’ right to property includes the use and enjoyment of these lands and the fish they have traditionally harvested. As the Court noted in *Saramaka* case, “[t]his connectedness between the territory and the natural resources necessary for [indigenous peoples] physical and cultural survival is precisely what needs to be protected under Article 21 of the Convention in order to guarantee the members of indigenous and tribal communities’ right to the use and enjoyment of their property.”⁴⁹⁰
234. Through its approvals of the B.C. Mines and its failures to adequately regulate and prevent the threats they pose to the transboundary watersheds, Canada has failed to take necessary and precautionary measures to guarantee Petitioners’ right to property provided for in Article XXIII of the American Declaration.

5. CANADA HAS NOT CONSULTED WITH OR OBTAINED THE FREE, PRIOR, AND INFORMED CONSENT OF PETITIONERS WITH RESPECT TO THE B.C. MINES

235. States in the Inter-American system have a general obligation “to consult with indigenous peoples and guarantee their participation in decisions regarding any measure that affects their territory, taking into consideration the special relationship between indigenous and tribal peoples and land and natural resources.”⁴⁹¹ This obligation is directly related to the right to cultural identity because of the intrinsic relationship between indigenous peoples’ way of life and their territory.⁴⁹²

236. The Inter-American Court and Commission have identified several requirements for adequate consultation. These include that consultation must be “prior,” meaning that it “must be carried out during the exploratory or planning phase” of a proposed project from the “very moment of evaluation of the grant of a concession.”⁴⁹³ Consultation is not a single act, but a “process of dialogue and negotiation that involves both parties’ good faith and the aim of reaching mutual agreement or consent.”⁴⁹⁴ Indigenous peoples “who lack formal titles of property over their territories must also be consulted in relation to the granting of extractive concessions.”⁴⁹⁵ Consultation must happen through culturally adequate procedures taking into account the affected indigenous people’s traditional decision-making methods.⁴⁹⁶ In addition, consultation must be informed and states must make those affected “aware of possible risks, including environmental and health risks” from a proposed project.⁴⁹⁷

237. The Inter-American Court has also required indigenous peoples’ free, prior, and informed consent when large-scale extraction projects like the B.C. Mines may affect their rights.⁴⁹⁸ For example, in *Saramaka People v. Suriname*, the Court explained that “when large-scale development or extraction projects could affect the integrity of the Saramaka people’s lands and natural resources, the State has a duty not only to consult with the Saramakas, but also to obtain their free, prior, and informed consent in accordance with their customs and traditions.”⁴⁹⁹

238. Applying the Commission’s and Court’s jurisprudence and other sources of international law, the UN Special Rapporteur on the rights of indigenous peoples concluded that even if the extractive activities do not take place within indigenous territory, the consent of indigenous peoples otherwise affected by those activities may nevertheless be required “depending upon the nature of and potential impacts of the activities on the exercise of their rights.”⁵⁰⁰ For example, the special rapporteur explained that where a large-scale resource extraction project may harm lands that support an indigenous group’s physical well-being or cultural practices in a manner that substantially affects that group’s substantive rights, international law may require the group’s consent before the project may go forward.⁵⁰¹

239. Consistent with its November 2017 advisory opinion on human rights and the environment, a state should obtain the free, prior, and informed consent of indigenous peoples outside the state’s territory when acts or omissions cause environmental impacts that violate human rights outside their territory. In this case, therefore, Canada should have consulted with Petitioners and obtained their free, prior, and informed consent

before permitting or approving the B.C. Mines because these projects significantly threaten Petitioners' human rights.

240. As explained above,⁵⁰² the governments of Canada and British Columbia have not consulted with or sought the free, prior, and informed consent of Petitioners during the approval or permitting of any of the B.C. Mines. They have not assessed, or required the mine proponents to assess, transboundary impacts in the watersheds, thus limiting Petitioners' ability to understand the potential threats to their rights to culture, adequate means of subsistence, health, and the right to use and enjoy their traditionally-occupied territory. Likewise, they have not sought any information from Petitioners concerning how pollution from any of the mines might harm Petitioners' human rights.

VI. EXHAUSTION OF DOMESTIC REMEDIES

241. The Inter-American Commission's rules of procedure require that the Commission "verify whether the remedies of the domestic legal system have been pursued and exhausted in accordance with the generally recognized principles of international law."⁵⁰³ Exhaustion is not required when "the domestic legislation of the state concerned does not afford due process of law for protection of the right or rights that have allegedly been violated"⁵⁰⁴ or "when it is evident from the case file that any action filed regarding that complaint had no reasonable chance of success based on the prevailing jurisprudence of the highest courts of the State."⁵⁰⁵ The Commission does not merely look to the formal existence of remedies, but rather, whether the legal remedy is "adequate" and "suitable and effective" in redressing the violations at issue.⁵⁰⁶

242. The Commission has also held that "judicially beneficial laws" aimed at protecting indigenous rights "cannot by themselves guarantee the right of such peoples."⁵⁰⁷ Rather, "[s]tates must effectively implement and enforce the constitutional, legislative and regulatory provisions of their internal law that enshrine the rights of indigenous and tribal peoples and their members, so as to ensure the real and effective enjoyment of such rights."⁵⁰⁸

243. As explained below, Canadian law offers Petitioners "no reasonable chance of success" due to the financial burden administrative and court challenges would impose⁵⁰⁹ and the lack of adequate and effective redress for the harms and rights at issue in this petition.⁵¹⁰ Thus, the petition is admissible under the Commission's rules of procedure.

A. PETITIONERS' EFFORTS TO VOICE THEIR CONCERNS REGARDING THE B.C. MINES

244. As discussed above, the governments of British Columbia and Canada have not consulted with or sought Petitioners' free, prior, and informed consent during the permitting or approval of any of the B.C. Mines (see section V.C.5).

245. Instead, Petitioners have taken steps to protect their interests from threats posed by the B.C. Mines through various political and legal processes in the United States. On June 27, 2016, Petitioners and other groups submitted a petition to the U.S. Department of the Interior describing grounds for investigation of the B.C. Mines pursuant to the Pelly

Amendment to the Fishermen’s Protective Act of 1967.⁵¹¹ On September 26, 2017, they submitted the same petition to the U.S. Department of Commerce.⁵¹² To date, the Government of the United States has not taken any actions in response to these petitions.

246. Petitioners have also raised concerns and sought information about the B.C. Mines with and from various Alaskan government officials. Petitioners testified before the Alaska Legislature’s House Special Committee on Fisheries on October 12, 2016. Petitioners also met with then-Alaska Lieutenant Governor Byron Mallott on May 25, 2017, October 25, 2017 and January 17, 2018. Canadian Consul General Brandon Lee was present at the January 17, 2018 meeting, at which Alaskan and Canadian officials discussed issues concerning the transboundary watersheds, including salmon escapement, financial assurances for mining failures, climate change, scientific data needed to protect the five species of salmon, ongoing acid mine drainage from the Tulsequah Chief mining site, and elevated levels of selenium in the Stikine River.⁵¹³
247. On June 1, 2018, Petitioners attended a meeting in Juneau, Alaska, of the Bilateral Working Group on the Protection of Transboundary Waters, which was established through a Statement of Cooperation between the governments of Alaska and British Columbia.⁵¹⁴ At that meeting, the public had the opportunity to ask questions about the B.C. Mines and other transboundary water issues.⁵¹⁵ However, this Working Group is only a venue for the public to receive information and voice concerns, and has no authority to change decisions.⁵¹⁶

B. PURSUING REMEDIES AT THE DOMESTIC LEVEL WOULD IMPOSE AN UNDUE FINANCIAL BURDEN ON PETITIONERS

248. In its advisory opinion on *Exceptions to the Exhaustion of Domestic Remedies*, the Inter-American Court explained that “if it can be shown that an indigent needs legal counsel to effectively protect a right which the Convention guarantees and his indigency prevents him from obtaining such counsel, he does not have to exhaust the relevant domestic remedies.”⁵¹⁷ In *Hul’Qumi’Num Treaty Group*, the Commission held that the petitioners had satisfied the exhaustion requirement in part because “access to Canadian courts [wa]s very costly for [the petitioners] and ma[de] it impossible to lodge the legal remedies mentioned by the State.”⁵¹⁸ In the case of *Sipakepense Peoples v. Guatemala*, the Commission noted that the petitioners had satisfied the exhaustion requirements in part because “there were difficulties in filing the appeal owing to geographical distances and a lack of economic resources and technical assistance,” including “the costs of hiring specialized attorneys.”⁵¹⁹
249. The UN Special Rapporteur on the rights of indigenous peoples noted the high costs and delays that indigenous peoples in Canada have faced when seeking to protect their rights in court. For example, the Tshilhqot’in Nation’s aboriginal title litigation has cost the nation more than CAN\$15 million.⁵²⁰
250. In *Hul’Qumi’Num Treaty Group*, the Commission also recognized the high cost of legal remedies to Canadian First Nations.⁵²¹ For example, in one case concerning aboriginal title, the “case lasted more than 15 years and cost the indigenous peoples involved over

\$14 million, and due to the lack of financial resources they [were un]able to continue litigation in the courts.”⁵²² The Commission also recognized the high cost to the Tsilhqot’in people of litigating their claims “without having won the recognition of their property rights or the protection of their ancestral lands against the actions of third parties.”⁵²³

251. Requiring Petitioners to seek remedies under Canadian domestic law would impose an undue financial burden on them. To effectively challenge the technical and complex statutes and regulations related to the mining approvals, Petitioners would need to retain costly counsel and technical specialists, and to travel long distances to engage in public participation processes.⁵²⁴ In light of the financial burden Petitioners would face in having to challenge the B.C. Mines in Canadian courts, this petition falls within the exception to the requirement to exhaust domestic remedies.

C. CANADIAN LAW DOES NOT PROVIDE ADEQUATE OR EFFECTIVE REDRESS FOR PETITIONERS’ CLAIMS

1. CANADA’S ENVIRONMENTAL ASSESSMENT LAWS DO NOT ADEQUATELY OR EFFECTIVELY PROTECT PETITIONERS’ RIGHTS
252. The Commission has noted that general environmental laws, which typically incorporate requirements of information and participation during social and environmental review processes for proposed projects, “are usually insufficient to accommodate the requirements of consultation with indigenous peoples, visualized as a special mechanism to guarantee their rights and interest” as required by Inter-American human rights standards.⁵²⁵
253. These general concerns have been recognized in particular with respect to Canada’s environmental assessment laws. The B.C. Mines require approval under both the British Columbia Environmental Assessment Act (BC EAA) and the Canadian Environmental Assessment Act of 2012 (CEAA).⁵²⁶ Both laws have been criticized as inadequate and ineffective to protect the environment or indigenous peoples’ rights.⁵²⁷

British Columbia Environmental Assessment Act

254. Critics note that the BC EAA process lacks accountability and credibility.⁵²⁸ For example, the act does not set out an approval test or criteria for decision-making, including no criteria for considering the interests of potentially affected indigenous peoples.⁵²⁹ Without “decision-making criteria or rules governing how to deal with trade-offs, including which trade-offs are unacceptable (such as crossing an ecological limit), decisions often appear arbitrary, politicized and unjust.”⁵³⁰ For example,

the environmental assessments of [the] proposed Prosperity Mine and BC Hydro’s proposed Site C dam both concluded that the projects would result in significant adverse environmental impacts, and recognized the opposition of the Indigenous peoples in whose territories the projects are located. In both cases, the provincial government approved the project anyway, accepting the significant

adverse impacts with little or no “justification” provided for the decision.⁵³¹

255. In addition, courts have made it difficult to successfully challenge environmental authorizations by according the government near-unlimited discretion under the BC EAA.⁵³² The law does not require

decision-makers to base decisions on the best available science or Indigenous knowledge, or to provide reasons for their decisions. It also does not establish a right of appeal. As a result, courts have consistently held that decision-makers be accorded broad deference under the EAA, making it more difficult to challenge decisions that ignore important information or community concerns.⁵³³

256. The BC EAA has also been criticized as not requiring adequate assessment of the cumulative effects of projects, because the law makes the power to consider cumulative effects “discretionary,” not legal.⁵³⁴ British Columbia’s Auditor General found in 2015 that the province’s environmental assessment procedures “do not effectively support the management of cumulative effects.”⁵³⁵

257. Importantly, the BC EAA does not meet the international law requirements for prior consultation with indigenous peoples set out above in section V.C.5.⁵³⁶ To begin with, restrictive timelines and vague requirements for the public and indigenous groups to comment on a project proponent’s application – which is typically highly technical and voluminous – makes it challenging to meaningfully participate in the process.⁵³⁷ The Public Consultation Policy Regulation to the BC EAA requires that an assessment include one public comment period of between 30 and 75 days, and a second one at the decision-maker’s discretion.⁵³⁸ This is not enough time for most indigenous groups to meaningfully review potentially thousands of pages of technical documents and submit comments.

258. In addition, the Public Consultation Policy Regulation directs project proponents to design the details of the public participation process subject to the approval of the government.⁵³⁹ This is problematic because “the proponent clearly has a direct interest in the outcome of the assessment, thus members of the public are often rightly cautious that opportunities for their participation, and how their input is portrayed, will be limited or framed in a way that best serves the interests of the proponent.”⁵⁴⁰

259. The BC EAA also does not require assessment of a project’s potential impacts on indigenous rights.⁵⁴¹ Although in practice such an assessment often takes place, indigenous groups are not adequately consulted and it is “a murky and ill-defined process, with the proponent being delegated the task of collecting the relevant information and the [government] doing the interpretation of it.”⁵⁴² The British Columbia First Nations Energy and Mining Council⁵⁴³ commented that this “scheme is unilaterally designed and implemented, without consultation with the affected First Nation. Consequently, it incorporates methods for assessing strength of claim that are

not legally recognized, and reaches flawed determinations of impact magnitude and significance – all this without any engagement of the First Nation in the analysis.”⁵⁴⁴

260. In summary, the BC EAA is ineffective and inadequate to protect Petitioners’ rights. As the BC First Nations Energy and Mining Council concluded, “Far from being the independent, neutrally administered, technically robust, transparent and accountable process it needs to be, the Act is constructed to achieve the opposite of these characteristics in its implementation. … A significant number of First Nations has lost the confidence in the process.”⁵⁴⁵

Canadian Environmental Assessment Act

261. The CEAA has also been criticized as ineffective and inadequate to protect indigenous peoples.⁵⁴⁶ For example, before he became UN Special Rapporteur on human rights and the environment, Professor David Boyd noted that “First Nations, communities, and environmental groups argue that federal [environmental assessment] is too narrowly focused, happens too late, offers inadequate opportunities for Indigenous and public participation, and ultimately serves as a rubber stamp.”⁵⁴⁷ Other commentators have noted that the CEAA weakens “Aboriginal Peoples’ capacity to participate in the resource development review process of undertakings that affect their traditional lands. The result is the silencing of the people who are most affected by resource development.”⁵⁴⁸ In summary, Petitioners cannot effectively use the CEAA to protect their rights.

2. CANADA’S INDIGENOUS LAWS DO NOT ADEQUATELY OR EFFECTIVELY PROTECT PETITIONERS’ RIGHTS

262. Although Canada has developed a special legal framework and body of jurisprudence concerning indigenous peoples’ rights, their application has been inadequate and ineffective to First Nations within Canada, and even less effective to foreign tribes.⁵⁴⁹

263. The Inter-American Commission has held that shortcomings in the content and application of Canadian laws applicable to indigenous peoples make those laws inadequate to protect indigenous peoples’ rights, and therefore support the application of the exception to exhaustion of domestic remedies. In *Hul’Qumi’Num Treaty Group*, the petitioners alleged that Canada had violated the human rights of the Hul’Qumi’Num Treaty Group because of its failure to legally recognize the petitioners’ ancestral lands and to consult with the petitioners prior to granting concessions that destroyed the environmental and natural resources of the petitioners’ ancestral lands and sacred sites.⁵⁵⁰

264. Canada argued that the petitioners could have exhausted available domestic remedies, including through the treaty negotiation process under the British Columbia Treaty Commission (BCTC); legal actions to obtain recognition of aboriginal title and compensation for the violation of that right; filing petitions under the provisions of the Heritage Preservation Act to demand that the Crown fulfill its obligation to conduct prior consultation with indigenous peoples; petitioning for interim or interlocutory measures against violations; and legal action under the provisions of the Canadian Charter of

Rights and Freedoms.⁵⁵¹ Because Canada promoted the BCTC “as an ideal mechanism to address, in a comprehensive manner, the territorial claims of indigenous people,” the Commission’s analysis focused on the effectiveness of that process “as an important reference point to evaluate the exhaustion of remedies by the petitioners.”⁵⁵²

265. The Commission held that the petitioners did not have to exhaust domestic remedies because the central claims of the Hul’Qumi’Num Treaty Group had not been resolved under the BCTC after fifteen years.⁵⁵³ In addition, the Commission noted the “difficulties faced by indigenous peoples when trying to avail themselves of the [BCTC process] due to the limited access to the justice system during and following treaty negotiations.”⁵⁵⁴ The Commission concluded that “by failing to resolve the [Hul’Qumi’Num Treaty Group] claims with regard to their ancestral lands, the BCTC process has demonstrated that it is not an effective mechanism to protect” the rights claimed by the petitioners.⁵⁵⁵
266. The Commission also addressed possible remedies under the Canadian Heritage Preservation Act and the Canadian Charter of Rights and Freedoms. It held those remedies to be unsuitable “because they [could] not be used to comprehensively and permanently protect all [of the petitioners’] ancestral lands from the actions of third parties because their purpose is not to recognize [the petitioners’] property rights to those lands or the obligation of the State to provide restitution.”⁵⁵⁶
267. The Canadian domestic remedies referred to in *Hul’Qumi’Num Treaty Group* would likely be even less effective or suitable for protecting Petitioners here because they live outside Canada and are likely not protected by the Canadian laws.
268. The UN Special Rapporteur on the rights of indigenous people has also noted the ineffectiveness of Canadian indigenous laws. During a 2013 visit to Canada, he explained:

It is difficult to reconcile Canada’s well-developed legal framework and general prosperity with the human rights problems faced by indigenous peoples in Canada that have reached crisis proportions in many respects. Moreover, the relationship between the federal Government and indigenous peoples is strained, perhaps even more so than when the previous Special Rapporteur visited Canada in 2003, despite certain positive developments that have occurred since then and the shared goal of improving conditions for indigenous peoples.⁵⁵⁷

269. The special rapporteur found that in Canada, the “treaty and other claims processes have been mired in difficulties,” and that as a result “many First Nations have all but given up on them. Worse yet, in many cases it appears that these processes have contributed to a deterioration rather than renewal of the relationship between indigenous peoples and the Canadian State.”⁵⁵⁸ Further,

Many negotiations under these procedures have been ongoing for many years, in some cases decades, with no foreseeable end. An overarching concern is that the Government appears to view the overall interests of Canadians as adverse to aboriginal interests, rather than encompassing them. In the comprehensive land claims processes, the Government minimizes or refuses to recognize aboriginal rights, often insisting on the extinguishment or non-assertion of aboriginal rights and title, and favours monetary compensation over the right to, or return of, lands. In litigation, the adversarial approach leads to an abundance of pre-trial motions, which requires the indigenous claimants to prove nearly every fact, including their very existence as a people.⁵⁵⁹

270. The special rapporteur also noted the long delays First Nations face in pursuing claims using Canadian indigenous laws. For example, he referred to the Tshilhqot'in Nation's aboriginal title litigation, which at the time of his visit "had taken 14 years to pursue, including five years of trial, and the case is currently under appeal to the Supreme Court of Canada."⁵⁶⁰ The Nuu-chah-nulth Nation's litigation over a commercial aboriginal right to fish has taken 12 years, including three years of trial and successive appeals.⁵⁶¹ The special rapporteur also referred to "four indigenous nations in the Treaty 8 territory in British Columbia [that] have been in Treaty Land Entitlement negotiations for a decade, for 'so long that there are almost no available lands left for the First Nations to select.'"⁵⁶² He concluded that "[i]t is understandable that First Nations who see the lands and resources over which they are negotiating being turned into open pit mines or drowned by a dam would begin to question the utility of the process."⁵⁶³

3. CANADA'S CONSTITUTIONAL LAW DOES NOT ADEQUATELY OR EFFECTIVELY PROTECT PETITIONERS' RIGHTS

a. *The Canadian Constitution imposes no positive obligation on government to protect and preserve any indigenous right*

271. Petitioners would have no reasonable chance of success in challenging the B.C. Mines under Canadian constitutional law, which is contained in Canada's Constitution Act of 1982 (Constitution Act).⁵⁶⁴ This act contains the Canadian Charter of Rights and Freedoms, "which guarantees the rights and freedoms set out in it subject only to such reasonable limits prescribed by law as can be demonstrably justified in a free and democratic society."⁵⁶⁵ However, while the Constitution Act contains a section on aboriginal rights (Section 35), Canadian courts have held that Section 35 "imposes no positive obligation on government to protect and preserve any aboriginal right."⁵⁶⁶ For instance, in *Davis v. Canada*, the plaintiffs argued that Canada had failed to recognize their identity as an aboriginal people and consequently had failed to establish programs and services as it had done for other peoples under the Indian Act.⁵⁶⁷ As the Newfoundland and Labrador Supreme Court explained,

[e]ven assuming that aboriginal identity, as such, can represent an aboriginal right..., s. 35 as interpreted by the Supreme Court of

Canada provides absolutely no basis for the imposition on government of an obligation to take any steps to preserve that right. If the right is proven to exist before European contact, and otherwise satisfies the analysis required for its acceptance, s. 35(1) operates to provide constitutional protection against its infringement by government action. That is the extent of the protection offered; it does not go so far as to oblige government to take positive measures to ensure the continued existence of the right. In my view, the claim that the plaintiffs are entitled to relief based on the assertion that government has failed to protect a s. 35(1) aboriginal right is certain to fail.⁵⁶⁸

272. In a November 2017 decision, the Supreme Court of Canada further demonstrated the ineffectiveness of Section 35 to ensure enjoyment of the rights of indigenous and tribal peoples and their members.⁵⁶⁹ The court held that the development of a large ski resort on Ktunaxa sacred land violated their right to freedom of religion by permanently damaging their ability to practice their spiritual traditions and beliefs.⁵⁷⁰ The court held that “Section 35 guarantees a process, not a particular result,” and that “there is no guarantee that, in the end, the specific accommodation sought will be warranted or possible.”⁵⁷¹ Because the Minister of Forests, Lands and Natural Resource Operations had shown attempts at consultation, and because the minister’s decision “is entitled to deference,” the court dismissed the Ktunaxa Section 35 claims.
273. Because Section 35 of the Constitution Act imposes no positive obligation on government to protect and preserve any indigenous right, but only creates a procedural obligation on the government, Petitioners would have no reasonable chance of success on a Section 35 claim seeking protection of their rights.

b. *The Canadian Constitution does not provide an adequate and effective remedy for the rights to culture, property, health, and own means of subsistence*

Right to culture

274. Canadian law does not provide an adequate, effective, or suitable remedy for protecting the right to culture and does not provide adequate redress for the violations alleged by the Southeast Alaskan indigenous peoples in this petition. The only reference to culture in the Constitution Act is in Section 27, which states, “This Charter shall be interpreted in a manner consistent with the preservation and enhancement of the multicultural heritage of Canadians.”⁵⁷² However, the culture described in Section 27 is *Canada’s* multicultural heritage, preservation of which does not protect a particular people’s right to culture. It therefore is not applicable in this case.

Right to property or the right to use and enjoy traditionally-occupied lands

275. The Canadian Constitution does not recognize the right to property or the right to use and enjoy traditionally-occupied lands. The Canadian government has negotiated agreements, known as “modern treaties,” with certain indigenous groups, but, as

mentioned above, the government is not obligated to negotiate treaties with foreign tribes. In any event, as also discussed above, the Commission held that the recourse available through a modern treaty process regarding a treaty group's right to their ancestral lands was not effective.⁵⁷³ In addition, to the extent that Canadian law protects indigenous peoples' right to property as part of their aboriginal rights, such a claim falls under Section 35 of the Constitution Act, and would have no reasonable chance of success, as discussed above.

Right to health

276. The Constitution Act does not recognize a right to health.

Right to their own means of subsistence

277. Neither the Constitution Act nor other Canadian legislation recognizes or provides any protection for a right to one's own means of subsistence.

VII. TIMELINESS

278. Under Article 32 of the Commission's Rules of Procedure, a petition should be lodged within six months of notification of the final ruling that comprises the exhaustion of domestic remedies. For cases in which the exhaustion requirement does not apply, "the petition shall be presented within a reasonable period of time, as determined by the Commission. For this purpose, the Commission shall consider the date on which the alleged violation of rights occurred, and the circumstances of each case."⁵⁷⁴

279. This petition is timely because, as described in section IV.B.5, the acts and omissions of Canada and British Columbia that form the basis for the petition are ongoing, and the individual and cumulative threat of serious pollution from the B.C. Mines present an imminent and significant risk to Petitioners' human rights. British Columbia and Canada have failed to take effective action to prevent pollution and environmental damage from mines operating in the U.S.-Canada transboundary watersheds. It is also unlikely that these governments will adequately consider and address potential threats to Petitioners from the mines that are still in the permitting phase. These governments do not require proposed mines to assess transboundary water quality impacts and they continue to authorize mines that are using unsafe pollution containment and treatment processes. Particularly concerning, the governments also have not consulted with or sought the free, prior, and informed consent of Petitioners regarding any of the B.C. Mines. Thus, it is necessary for the Commission to take urgent measures now to prevent violation of Petitioners' human rights from all of the B.C. Mines.

280. For the above reasons, this petition is timely.

VIII. ABSENCE OF PARALLEL INTERNATIONAL PROCEEDINGS

281. The subject of this petition is not pending in any other international proceeding for settlement, nor does it duplicate any petition pending before or already examined by the Commission or any other international governmental organization.

IX. REQUEST FOR RELIEF

282. States' responsibility to prevent breaches of international law and remedy them when they occur is a foundational principle of international law codified in the American Convention on Human Rights.⁵⁷⁵
283. The Inter-American Court has held reparations to include non-monetary measures, including environmental protection measures. For instance, in *Xákmok v. Paraguay*, the Court not only ordered Paraguay to return the petitioners' land, but also, until it did so, prevent deforestation or other exploitation that would cause irreparable damage to the land or the natural resources on it.⁵⁷⁶ The Court recognized that monetary compensation for loss of or damage to the petitioners' land was not "capable of repairing the damage caused by the violations declared" in that judgment,⁵⁷⁷ and accordingly identified environmental protection measures as a form of reparations.⁵⁷⁸ In a similar vein, Canadian law acknowledges that "the Government of Canada must be able to fulfill its international obligations in respect of the environment"⁵⁷⁹ and includes among the government's administrative duties the duty to "take preventive and remedial measures to protect, enhance and restore the environment."⁵⁸⁰
284. The UN Special Rapporteur on the rights of indigenous people has also recognized states' obligations to take measures to address the effects of extractive industries on indigenous peoples. In his 2014 report on indigenous peoples' rights in Peru with regard to the extractive industries, the special rapporteur highlighted the need for states to develop "a regulatory framework that fully recognizes indigenous peoples' rights over lands and natural resources and other rights that may be affected by extractive operations . . . and that provides effective sanctions and remedies when those rights are infringed either by government or by corporate actors."⁵⁸¹
285. By authorizing mines that would irreversibly pollute habitat for salmon and other fish populations and threaten these fish with significant and sustained population declines, Canada is allowing domestic actors under its jurisdiction to impose the environmental costs of their operations on Petitioners, thus violating their rights.
286. Canada therefore has a duty to provide appropriate remedy and redress, which may include environmental protection measures, to Petitioners.
287. In light of the violations described above, Petitioners respectfully request that the Commission:
 - 1) Make an onsite visit to investigate and confirm the threats to the Southeast Alaskan Native communities from the B.C. Mines;
 - 2) Hold a hearing to investigate the claims raised in this petition;
 - 3) Prepare a report setting forth all the facts and applicable law, declaring that Canada's failure to implement adequate measures to prevent the harms to Petitioners from the B.C. Mines violates rights affirmed in the American Declaration of the Rights and Duties of Man, and recommending that Canada:

- a. Suspend approvals and/or operations of the B.C. Mines until it has thoroughly assessed and addressed the risk to Petitioners' human rights;
- b. Consult with Petitioners and seek their free, prior and informed consent with respect to each of the B.C. Mines as required by international law;
- c. Establish and implement, in coordination with Petitioners, a plan to protect the Petitioners and the resources they depend on from the disastrous effects of pollution from the B.C. Mines, including the watersheds and fish species used by the Southeast Alaskan Native communities whose rights have been violated; and
- d. Provide any other relief that the Commission considers appropriate and just.

ENDNOTES

¹ Southeast Alaska Indigenous Transboundary Commission’s web page, <http://www.seitc.org/>.

² See section IV.A.

³ See *id.*

⁴ Rivers Canada, *Imminent Threats to the Survival of a Wild Taku Watershed: Re: Tulsequah Chief Acid Generating Mine and 160 [kilometer] Access Road Proposed by Redfern Resources Ltd.* at PDF 3 (Nov. 12, 1996).

⁵ John. S. Richardson & Alexander M. Milner, *Pacific Coast Rivers of Canada and Alaska*, in RIVERS OF NORTH AMERICA 735, 772 (Arthur C. Benke & Colbert E. Cushing eds., 2005) (Richardson & Milner).

⁶ *Id.* at 760, 772.

⁷ *Id.* at 772.

⁸ *Id.* at 774.

⁹ SEITC Interview with Britany *Kee’ ya aa*. Lindley (2017) on file with Earthjustice (Lindley Interview).

¹⁰ Richardson & Milner, *supra* note 5, at 751.

¹¹ *Id.*; also <http://www.wrangell.com/visitorservices/stikine-river>.

¹² Red Chris Development Company Ltd., Application for an Environmental Assessment Certificate, Red Chris Project, British Columbia, Canada at 4-186, 4-188 (Oct. 2004) (Red Chris EA Application); Robert J. Behnke, TROUT AND SALMON OF NORTH AMERICA at 329 (2010); Richardson & Milner, *supra* note 5, at 754, 767.

¹³ *Id.*

¹⁴ Rivers Without Borders, *About the Region*, <https://riverswithoutborders.org/about-the-region/unuk>.

¹⁵ Ketchikan Indian Community, *About Us*, <http://www.kictribe.org/about/index.html>; SEITC Interview with Louis Wagner (2017) on file with Earthjustice (Wagner Interview).

¹⁶ Wagner Interview, *supra* note 15.

¹⁷ *Id.*

¹⁸ Seabridge Gold, Application for an Environmental Assessment Certificate / Environmental Impact Statement: KSM Project at 15-45 (July 2013) (KSM EA Application); Transboundary Watershed Alliance, The Unuk River Watershed of Southeast Alaska/Northwest British Columbia at PDF 3 (March 2001) (Transboundary Watershed Alliance).

¹⁹ KSM EA Application, *supra* note 18, at 15-45; Transboundary Watershed Alliance, *supra* note 18, at PDF 2.

²⁰ Transboundary Watershed Alliance, *supra* note 18, at PDF 3; KSM EA Application, *supra* note 18, at 15-42, Tbl. 15.1-4; see also *id.* at 15-20 (“The Unuk and Bell-Irving rivers are large river systems with diverse fish communities and cultural values. They provide spawning routes for Pacific salmon (*Oncorhynchus* spp.), anadromous steelhead (*O. mykiss*), and cutthroat trout (*O. clarkii clarkii*), and serve as habitat for resident rainbow and cutthroat trout, Dolly Varden (*Salvelinus malma*), bull trout (*S. confluentus*), and mountain whitefish (*Prosopium williamsoni*).”).

²¹ Transboundary Watershed Alliance, *supra* note 18, at PDF 1 (“U.S. conservationists early on recognized its importance and worked hard to have the entire lower portion of it protected within Misty Fjords National Monument.”).

²² *See id.* at PDF 4.

²³ Wagner Interview, *supra* note 15.

²⁴ *See id.*

²⁵ SEITC Interview with Einar Haaseth (2017) on file with Earthjustice (Haaseth Interview); SEITC Interview with Tammi Meissner (2017) on file with Earthjustice (Meissner Interview); SEITC Interview with John Morris, Sr. (2017), on file with Earthjustice (Morris Interview); Wagner Interview, *supra* note 15.

²⁶ *Id.*

²⁷ Megan Felicity Moody, *Eulachon Past and Present*, University of British Columbia at ii (March 2008) (Moody). Despite its importance to Alaska Native communities, as well as to many First Nations in British Columbia, eulachon has been little studied, perhaps because it has never been commercially harvested. Scientists have documented a decline in returns over the past 20 years throughout their habitat along the Pacific coast, particularly in the 1990s, but do not understand the causes of these trends. Climate change and the destruction of eulachon spawning habitat have been hypothesized as potential causes. *See generally*, J. B. MacKinnon, ‘*Salvation Fish’ That Sustained Native People Now Needs Saving*, NATIONAL GEOGRAPHIC (July 7, 2015), <http://news.nationalgeographic.com/2015/07/150707-salvation-fish-canada-first-nations-animals-conservation-world/>.

²⁸ Lindley Interview, *supra* note 9; Meissner Interview, *supra* note 25; Haaseth Interview, *supra* note 25.

²⁹ *See, e.g.*, Wagner Interview, *supra* note 15.

³⁰ SEITC Interview with James Stough, Sr. (2017) on file with Earthjustice (Stough Interview).

³¹ *Id.*

³² Lindley Interview, *supra* note 9.

³³ For example, eulachon is a nutritious food high in unsaturated fats and vitamin A, E, and K. Moody, *supra* note 27, at ii.

³⁴ *See, e.g.*, Robert J. Wolfe, *Local traditions and subsistence: a synopsis from twenty-five years of research by the State of Alaska*, Technical Paper 284, at 14 (2005) (noting that “subsistence harvests in rural areas … are a necessary part of economic survival in rural Alaskan communities where incomes are low, prices are high, and imported food unreliable.”); *see also* Lindley Interview, *supra* note 9; Meissner Interview, *supra* note 25.

³⁵ Meissner Interview, *supra* note 25; *see also* Wolfe, *supra* note 34, at 13 (“It is not uncommon for [Alaskan] village stores to run out of many commercial products, particularly when weather interferes with shipments”).

³⁶ John Sisk, Subsistence Use in Southeastern Alaska, https://www.conservationsgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/alaska/seak/era/cfm/Documents/9.1_Subistence.pdf (citing Alaska Department of Fish and Game, Subsistence in Alaska: a year 2000 update, Division of Subsistence, Juneau, AK).

³⁷ U.S. Census Bureau estimates that the average per capita income for American Indians and Alaska Natives in Metlakatla is \$20,315, in Wrangell \$22,771, and in the Juneau Borough, where the Dougal

Indian Association is located, \$24,843. U.S. Census Bureau, *Per Capita Income in the Past 12 Months (in 2015 Inflation-Adjusted Dollars) (American Indian and Alaska Native Alone)*, 2011-2015 American Community Survey 5-Year Estimates (Oct. 27, 2017).

³⁸ Morris Interview, *supra* note 25.

³⁹ Meissner Interview, *supra* note 25.

⁴⁰ Lindley Interview, *supra* note 9.

⁴¹ *Id.*

⁴² Meissner Interview, *supra* note 25.

⁴³ Wagner Interview, *supra* note 15.

⁴⁴ Morris Interview, *supra* note 25.

⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ *Id.*

⁴⁸ Meissner Interview, *supra* note 25.

⁴⁹ *Id.*

⁵⁰ Lindley Interview, *supra* note 9; Meissner Interview, *supra* note 25; Morris Interview, *supra* note 25; Wagner Interview, *supra* note 15. See also Matthew Brock & Philippa Coiley-Kenner, *A Compilation of Traditional Knowledge About the Fisheries of Southeast Alaska*, Alaska Dep’t of Fish and Game Division of Subsistence, Technical Paper No. 332 at 11 (Sept. 2009) (Brock & Coiley-Kenner).

⁵¹ Kirk Dombrowski, *Subsistence Livelihood, Native Identity and Internal Differentiation in Southeast Alaska*, 49 ANTHROPOLOGICA 211, 213, 216, 218 (2007).

⁵² Brock & Coiley-Kenner, *supra* note 50, at 4.

⁵³ *Id.* at 3-4.

⁵⁴ Dombrowski, *supra* note 51, at 216-17.

⁵⁵ Haaseth Interview, *supra* note 25.

⁵⁶ Stough Interview, *supra* note 30.

⁵⁷ Wagner Interview, *supra* note 15.

⁵⁸ Lindley Interview, *supra* note 9.

⁵⁹ Report of David M. Chambers, Ph.D, P. Geop., ¶¶ 13-21 (Nov. 14, 2018) (Chambers Report), attached here as Appendix 1.

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² See, generally, *id.*

⁶³ Chambers Report, *supra* note 59, ¶ 23.

⁶⁴ *Id.*

⁶⁵ *Id.*, ¶ 24.

⁶⁶ *Id.*

⁶⁷ *Id.*, ¶¶ 23, 26.

⁶⁸ *Id.*, ¶¶ 23, 28.

⁶⁹ *Id.*, ¶ 31.

⁷⁰ *Id.*, ¶ 32.

⁷¹ *Id.*

⁷² *Id.*

⁷³ *Id.*

⁷⁴ *Id.*, ¶ 33.

⁷⁵ *Id.*, ¶ 29.

⁷⁶ See Environmental Law Centre, University of Victoria, *Fixing Systemic Failures in BC's Mining Regulation: The Urgent Need for a Judicial Inquiry* at 37-9 (March 2017) (Environmental Law Centre Report), http://www.elc.uvic.ca/wordpress/wp-content/uploads/2017/03/2016-03-02-MiningPublicInquiry_2017Mar8.pdf. See also Brian Lynch, *Clean up that damn mine*, JUNEAU EMPIRE (Aug. 17, 2018), <https://www.juneauempire.com/opinion/clean-up-that-damn-mine/>; Ed Schoenfeld, *British Columbia will clean up mine near Juneau*, KTOO PUBLIC MEDIA (Jan. 3, 2017), <http://www.ktoo.org/2017/01/03/british-columbia-will-clean-up-mine-upstream-of-juneau/>.

⁷⁷ SLR, 2016 Aquatic Ecological Risk Assessment Tulsequah Chief Mine, Skeena Region at i (Apr. 2017), https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-permitting-and-compliance/tulsequah/2017-04-17_tulsequah_mine_aera_slr_final_report.pdf.

⁷⁸ Environmental Law Centre Report, *supra* note 76, at 38.

⁷⁹ *Id.*

⁸⁰ *Id.*

⁸¹ *Id.*; Chambers Report, *supra* note 59, at ¶ 68.

⁸² Environmental Law Centre Report, *supra* note 76, at 38. On November 6, 2018, the B.C. Government issued a Request for Proposal for the development of a Remediation Plan that will enable the mitigation of the ongoing contamination from the old Tulsequah Chief Mine. See British Columbia, Ministry of Energy, Mines, and Petroleum Resources, Tulsequah Chief Mine Remediation and Closure Plan (Nov. 6, 2018), <https://www.bcbid.gov.bc.ca/open.dll/welcome?language=En> (search for “Tulsequah” under “Browse Using The Advanced Search.”).

⁸³ Kendra Zamzow, PhD, Reliability of water quality predictions at the KSM mine relevant to aquatic life in the Unuk River at 9 (Mar. 21, 2018) (Zamzow Assessment), attached here as Appendix 2.

⁸⁴ Chambers Report, *supra* note 59, ¶ 34.

⁸⁵ *Id.*, ¶¶ 16, 17.

⁸⁶ *Id.*, ¶ 16.

⁸⁷ *Id.*, ¶¶ 17, 18.

⁸⁸ *Id.*, ¶ 19.

⁸⁹ *Id.* ¶ 20.

⁹⁰ *Id.*

⁹¹ *Id.*

⁹² *Id.*, ¶¶ 34-35.

⁹³ *Id.*, ¶¶ 38-43.

⁹⁴ *Id.*, ¶ 39.

⁹⁵ *Id.*

⁹⁶ *Id.*, ¶ 35.

⁹⁷ *Id.*

⁹⁸ Flávio Fonseca do Carmo *et al.*, *Fundão tailings dam failures: the environment tragedy of the largest technological disaster of Brazilian mining in global context*, 15 PERSPECTIVES IN ECOLOGY & CONSERVATION 145, 145 (2017) (Fonseca do Carmo *et al.*).

⁹⁹ Dom Phillips, *Brazil dam disaster: firm knew of potential impact months in advance*, THE GUARDIAN (Mar. 1, 2018), <https://www.theguardian.com/world/2018/feb/28/brazil-dam-collapse-samarco-fundao-mining>.

¹⁰⁰ Fonseca do Carmo *et al.*, *supra* note 98, at 146.

¹⁰¹ *Id.*

¹⁰² *Id.*

¹⁰³ *Id.* at 145-46.

¹⁰⁴ *Id.* at 148.

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* at 146.

¹⁰⁷ Luisa Torre & Patrik Camporez, *Life for Brazil's Krenak after Fundao dam collapse*, AL JAZEERA (July 3, 2017), <https://www.aljazeera.com/indepth/features/2017/05/life-brazil-krenak-fundao-dam-collapse-170518073228854.html>.

¹⁰⁸ *Id.*

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ UNEP, Mine Tailings Storage: Safety Is No Accident at 24-25 (2017), https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/371/original/RRA_MineTailings_lores.pdf?1510660693.

¹¹² Ian Bailey, *Mount Polley mine still at risk for future tailings breach: analyst*, THE GLOBE AND MAIL (Aug. 14, 2016), <https://www.theglobeandmail.com/news/british-columbia/mount-polley-mine-still-at-risk-for-future-tailings-breach-analyst/>.

¹¹³ Independent Expert Engineering Investigation and Review Panel, *Report on Mount Polley Tailings Storage Facility Breach*, at i, 6 (Jan. 30, 2015) (Expert Panel Report), <https://www.mountpolleyreviewpanel.ca/sites/default/files/report/ReportonMountPolleyTailingsStorageFacilityBreach.pdf>.

¹¹⁴ Environmental Law Centre Report, *supra* note 76, at 16.

¹¹⁵ *Id.*

¹¹⁶ *Id.* See also Jacinda Mack, *3 Years After The Mount Polley Disaster, Our Waters Are Still In Danger*, HUFFINGTON POST (July 28, 2017), http://www.huffingtonpost.ca/jacinda-mack/3-years-after-the-mount-polley-disaster-our-waters-are-still-in_a_23049981/.

¹¹⁷ Peter Moskowitz, *Mount Polley mine spill: A hazard of Canada's industry-friendly attitude?*, THE GUARDIAN (Aug. 13, 2014), <https://www.theguardian.com/environment/2014/aug/13/mount-polley-mine-spill-british-columbia-canada>.

¹¹⁸ Expert Panel Report, *supra* note 113, at i, 1.

¹¹⁹ *Id.* at iv.

¹²⁰ *Id.* at 118; see also, *id.*, App. I, Tbl. I 5.2.1 at 10.

¹²¹ *Id.* at App. I at 10, 12.

¹²² *Id.* at 122-25, 139.

¹²³ Environmental Law Centre Report, *supra* note 76, at 20.

¹²⁴ Auditor General of British Columbia, *An Audit of Compliance and Enforcement of the Mining Sector* at 5, 39 (May 2016), <http://www.bcauditor.com/sites/default/files/publications/reports/OAGBC%20Mining%20Report%20FINAL.pdf>. Dr. Chambers also explains that the substantial environmental risks posed by hard-rock mining operations can often be traced to government failures. Governments can fail to provide effective oversight of mining operations and tailings dam construction. Chambers Report, *supra* note 59, ¶ 42. High monitoring costs can reduce incentives to conduct adequate oversight. When governments pay attention to the environmental risks of mining, it is most often to the early stages of the mining process. They may promulgate regulations about initial design, but seldom make stipulations about ongoing stewardship. Governments may also often lack sufficient skilled staff to monitor conditions or address problems when they arise.

¹²⁵ Auditor General's Report, *supra* note 124, at 39.

¹²⁶ *Id.* at 4, 6.

¹²⁷ *Id.* at 11.

¹²⁸ *Id.* at 79.

¹²⁹ *Id.* at 84.

¹³⁰ *Id.* at 83.

¹³¹ *Id.* at 84.

¹³² *Id.* at 82.

¹³³ *Id.*

¹³⁴ *Id.* at 96.

¹³⁵ *Id.* at 98-102.

¹³⁶ *Id.* at 102.

¹³⁷ *Id.* at 41.

¹³⁸ *Id.* at 65-66.

¹³⁹ *Id.* at 65.

¹⁴⁰ *Id.* at 11.

¹⁴¹ *Id.* at 44.

¹⁴² *Id.* at 11, 45.

¹⁴³ *Id.* at 45.

¹⁴⁴ Environmental Law Centre Report, *supra* note 76, at 1.

¹⁴⁵ *Id.* at 1-2, 11-14.

¹⁴⁶ *Id.* at 17; *see also id.* at App. C. at 69-70.

¹⁴⁷ *Id.* App. C. at 69-70; Chambers Report, *supra* note 59, ¶ 42.

¹⁴⁸ *Id.* App. C. at 71; Chambers Report, *supra* note 59, ¶ 81.

¹⁴⁹ Chambers Report, *supra* note 59, ¶ 74.

¹⁵⁰ *Id.*, ¶ 73.

¹⁵¹ *See id.*

¹⁵² *See* Office of the Alaska Lieutenant Governor, Status of Select British Columbia Mine Projects at 3 (June 2018) (Status of Select British Columbia Mine), <https://ltgov.alaska.gov/wp-content/uploads/sites/6/2018/08/Transboundary-Mine-Projects-June2018.pdf>.

¹⁵³ Chieftain Metals is a company incorporated in Ontario and based on Toronto. *Chieftain Metals Incorporated*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00034516>.

¹⁵⁴ SRK Consulting, Big Bull Project, Tulsequah Chief Property, Technical Report Northern British Columbia at 6 (2010) (Big Bull 2010 Technical Report); JDS Energy & Mining Inc., Feasibility Study Technical Report, Tulsequah Chief Project, Northern British Columbia, Canada at 5-1 (Nov. 27, 2014) (Tulsequah Chief 2014 Technical Report).

¹⁵⁵ Tulsequah Chief 2014 Technical Report, *supra* note 154, at 5-1.

¹⁵⁶ *Id.* at 1-1; Big Bull 2010 Technical Report, *supra* note 154, at 6.

¹⁵⁷ *Id.* at 11-12.

¹⁵⁸ *See supra* ¶ 53.

¹⁵⁹ Tulsequah Chief 2014 Technical Report, *supra* note 154, at 1-20, Tbl. 1.10.

¹⁶⁰ JDS Energy & Mining Inc., Technical Report for the Tulsequah Chief Project of Northern British Columbia, Canada at 1-8, 1-10 (Jan. 22, 2013).

¹⁶¹ *Id.* at 1-10.

¹⁶² Tulsequah Chief 2014 Technical Report, *supra* note 154, at 18-24 to 18-28.

¹⁶³ *Id.* at 18-38, Tbl. 18.10.

¹⁶⁴ *Id.*; *see also id.* at 18-45 (describing the size of the tailings management facility); 18-38 (“The [tailings management facility] is located approximately 4 km upstream (north) of the main mine facilities on the east bank of the Shazah Creek.”); 5-2 (“Shazah Creek [is] close to its confluence with the Tulsequah River.”).

¹⁶⁵ Chambers Report, *supra* note 59, ¶ 74.

¹⁶⁶ Tulsequah Chief 2014 Technical Report, *supra* note 154, at 18-49. An acid treatment plant was also designed to treat discharges of acid mine drainage from the old mine works. *Id.* at 18-33.

¹⁶⁷ Chambers Report, *supra* note 59, ¶¶ 31-32, 58.

¹⁶⁸ See British Columbia Ministry of Sustainable Resource Management and British Columbia Ministry of Energy and Mines, Project Approval Certificate M02-01 (Dec. 12, 2002), <http://mines.nrs.gov.bc.ca/p/tulsequah-chief/authorizations>.

¹⁶⁹ Chieftain Metals Inc., Tulsequah Chief Mine Overview, <http://mines.nrs.gov.bc.ca/p/tulsequah-chief/authorizations>.

¹⁷⁰ Paul Tucker, *Owners of B.C.’s Tulsequah Chief mine site pushed into receivership*, CBC NEWS (Sept. 13, 2016) <http://www.cbc.ca/news/canada/north/tulsequah-chief-mine-bankrupt-receivership-1.3758668>; Status of Select British Columbia Mine Projects, *supra* note 152, at 3 (as of June 2018, “[t]he property remains in receivership, pending legal resolution.”).

¹⁷¹ Rivers Without Borders, Press Release, Company Drops Bid To Buy Tulsequah Chief Mine; New Study Shows “Unacceptable Risks” From Mine Pollution (Aug. 1, 2017), <http://riverswithoutborders.org/wp-content/uploads/2017/08/Tulsequah-Chief-buyer-backs-out-release.pdf>.

¹⁷² Imperial Metals is incorporated in British Columbia and based in Vancouver. *Imperial Metals Corporation*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00017753> (last visited Oct. 10, 2018).

¹⁷³ See Imperial Metals, Red Chris Mine, Overview (Oct. 2018), <https://www.imperialmetals.com/our-operations/red-chris-mine/overview> (indicating that commercial production started in July 2015, but the mine production dates back to February 17, 2015); Imperial Metals, Press Release, *Imperial Reports Red Chris Mine Receives Environmental Management Act (EMA) Permit* (June 15, 2015), http://www.imperialmetals.com/assets/docs/2015-06-15_nr.pdf (showing that amended tailings discharge permit was issued on June 12, 2015).

¹⁷⁴ Environmental Assessment Office, Red Chris Porphyry Copper-Gold Project Assessment Report at 5 (July 2005) (Red Chris EA Report).

¹⁷⁵ Klohn Crippen Berger Limited, *Tahltan Central Council: Red Chris Mine Site Review of Tailings Impoundment Design* at 4 (Oct. 2014), <http://tahltan.org/wp-content/uploads/2015/08/KCB-Red-Chris-Third-Party-Review.pdf>.

¹⁷⁶ Red Chris EA Application, *supra* note 12, at 4-348.

¹⁷⁷ *Id.*

¹⁷⁸ Chambers Report, *supra* note 59, ¶ 74.

¹⁷⁹ *Id.*

¹⁸⁰ Red Chris EA Application, *supra* note 12, at 4-348.

¹⁸¹ Red Chris EA Report, *supra* note 174, at 24.

¹⁸² Red Chris EA Application, *supra* note 12, at 4-349.

¹⁸³ *Id.*

¹⁸⁴ See, e.g., Red Chris EA Report, *supra* note 174, at 27 (“E[vironmental] A[ssessment] O[ffice] is satisfied that proposed mitigation measures and related commitments will prevent or reduce to acceptable levels any potential significant adverse water quality or [acid mine drainage/metals leaching] effects as they relate to the Project.”).

¹⁸⁵ Red Chris Development Company, Environmental Memorandum, Re: Red Chris Monitoring Committee Environmental Report Dec 1, 2015 – Dec 22nd, 2015 (Dec. 2015), <http://dnr.alaska.gov/commis/opmp/Canadian-Mines/Attachments/Red%20Chris%20Monitoring%20Committee%20Environmental%20Report%20December%201-15%202015.pdf>.

¹⁸⁶ Red Chris EA Report, *supra* note 174, at 81.

¹⁸⁷ *Id.*

¹⁸⁸ *Id.* at 23.

¹⁸⁹ Red Chris EA Application, *supra* note 12, at 4-347 (“The North dump has been sited so that all contaminated toe drainage from the dump will gravity flow into the tailings impoundment area during the mine’s operational life.”).

¹⁹⁰ Red Chris EA Report, *supra* note 174, at 23.

¹⁹¹ Red Chris EA Application, *supra* note 12, at 4-347.

¹⁹² *Id.*

¹⁹³ Red Chris EA Report, *supra* note 174, at 23.

¹⁹⁴ Copper Fox Metals is incorporated in Alberta and based in Calgary. *Copper Fox Metals Inc.*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00020511>.

¹⁹⁵ Teck Resources is incorporated in Canada and based in Vancouver. *Teck Resources Limited*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00001787>.

¹⁹⁶ Phyllis W. Scannell, Stikine River Mining Activity Risk Assessment, Alaska Department of Fish and Game, Technical Report No. 10-06 at 74-75 (2012) (Scannell).

¹⁹⁷ *Id.* at 75.

¹⁹⁸ *Id.*

¹⁹⁹ *Id.* at 75-76; Tetra Tech, Feasibility Study on the Schaft Creek Project, BC, Canada at 1-18; 18-19 to 18-21; 18-22, Fig. 18.6; 18-24 (Jan. 23, 2013) (Schaft Creek 2013 Feasibility Study).

²⁰⁰ Chambers Report, *supra* note 59, ¶ 74.

²⁰¹ Scannell, *supra* note 196, at 76.

²⁰² *Id.*

²⁰³ *Id.*

²⁰⁴ Copper Fox Metals, *Schaft Creek Project*, <http://www.copperfoxmetals.com/s/SchaftCreek.asp?numCols=1&page=2>.

²⁰⁵ *Id.*

²⁰⁶ Newmont, Press Release, *Newmont Acquires 50 Percent Stake in Galore Creek Project in British Columbia* (July 26, 2018), <https://www.newmont.com/newsroom/newsroom-details/2018/Newmont-Acquires-50-Percent-Stake-in-Galore-Creek-Project-in-British-Columbia/default.aspx>. Newmont is headquartered in Greenwood Village, Colorado. Newmont, *About Us*, <https://www.newmont.com/about-us/default.aspx>.

²⁰⁷ Teck Resources, *About Galore Creek*, <https://www.teck.com/operations/canada/projects/galore-creek-project/>. Teck Resources is incorporated in Canada and headquartered in Vancouver. *Teck Resources Limited*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00001787>.

²⁰⁸ AMEC Americas Limited, Galore Creek Project, British Columbia, NI 43-101 Technical Report on Pre-Feasibility Study at 1-2 & 14-13, Tbl. 14-4 (Sept. 2011) (Galore Creek Technical Report).

²⁰⁹ Scannell, *supra* note 196, at 28; Transport Canada *et al.*, Galore Creek Comprehensive Study Report at 36, 38-39 (Jan. 19, 20017) (Galore Creek Comprehensive Study Report) (“The effects of [potentially acid generating] waste rock will be controlled by submergence in the tailings and waste rock impoundment, adjacent to but separate from the tailings disposal area.”).

²¹⁰ Chambers Report, *supra* note 59, ¶ 74.

²¹¹ Galore Creek Comprehensive Study Report, *supra* note 209, at 76 (“Other variables indicated elevated concentrations of several elements known to be associated with specific minerals in the deposit. These included copper (chalcopyrite), zinc (sphalerite), lead (galena) and fluorine (fluorite). Initial results from kinetic tests demonstrated that most elements leach at low rates. However, copper, cadmium, fluoride, manganese, selenium, sulphate and zinc were leached at concentrations greater than typical water quality criteria. The water quality model determined that other variables, including calcium, barium, [aluminum], iron, boron, molybdenum, lead and antimony, would have significant loadings from waste rock to the tailings facility.”).

²¹² Rescan Environmental Services Ltd., Galore Creek Project Application for Environmental Assessment Certificate at 7-231 (June 2006).

²¹³ *Id.*

²¹⁴ See section IV.B.4.

²¹⁵ British Columbia Ministry of Environment and Ministry of Energy, Mines and Petroleum Resources, Environmental Assessment Certificate #M06-03 (Feb. 16, 2007), <https://projects.eao.gov.bc.ca/p/galore-creek-copper-gold-silver/docs>.

²¹⁶ Galore Creek Technical Report, *supra* note 208, at 20-1.

²¹⁷ See Mining News, *Novagold gets US\$275M for Galore Creek* (Aug. 10, 2018), <https://www.miningnewsnorth.com/story/2018/08/03/news/novagold-gets-us275m-for-galore-creek/5290.html>.

²¹⁸ Pretium Resources, *Brucejack Mine*, <https://www.pretivm.com/projects/brucejack-overview/default.aspx>; Pretium Resources is a company incorporated in British Columbia, and based in Vancouver. *Pretium Resources Incorporated*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00030613>; Pretium Resources Inc., Brucejack Gold Mine Project: Application for an Environmental Assessment Certificate / Environmental Impact Statement at 1-23 (June 2014) (Brucejack EA Application). The mine site will sit on the Brucejack Property, a 3,199-hectare area comprised of eleven mineral claims. *Id.* at 1-13. However, Pretium owns claims covering a larger area including the Snowfield and Bowser properties. See *id.* at 1-13, Fig. 5.3-1.

²¹⁹ Canadian Environmental Assessment Agency, Brucejack Gold Mine Project, Environmental Assessment Report at 23 & 24, Fig. 5 (July 2015) (Brucejack EA Report). The mine site will sit on the Brucejack Property, a 3,199-hectare area comprised of eleven mineral claims. Brucejack EA Application, *supra* note 218, at 1-13. However, Pretium Resources owns claims covering a much larger area including the Snowfield and Bowser properties. See *id.* at 1-13 & 1-14, Fig. 1.5-1.

²²⁰ Brucejack EA Application, *supra* note 218, at 1-29.

²²¹ Brucejack EA Report, *supra* note 219, at 7.

²²² *Id.* at 7, 11; Brucejack EA Application, *supra* note 218, at 1-30.

²²³ Brucejack EA Application, *supra* note 218, at 1-40, Tbl. 1.9-5.

²²⁴ *Id.* at 13-73 to 13-74.

²²⁵ *Id.* at 5-115 (“[I]t is estimated that about 0.67 million tonnes of [potentially acid-generating] development rock will be produced from the underground mine during the construction stage Approximately 4.2 Mt of waste rock, assumed to be [potentially acid-generating], will be produced by the underground mining throughout the operating period”).

²²⁶ *Id.* at 13-73 to 13-74.

²²⁷ *Id.* at 5-115 (“Over time, as appropriate voids become available underground, much of this rock will be used as backfill. About 37%, or 1.58 Mt, of waste rock generated from mining activities will be disposed of in the lake.”); *id.* at 5-118 (“Approximately 7.1 Mt of the flotation tailings will be used in paste backfill in the underground workings, while the rest will be deposited in Brucejack Lake.”).

²²⁸ Pretium Resources Inc., *Project History*, <https://www.pretivm.com/projects/History/default.aspx>.

²²⁹ Seabridge is a company incorporated under the Canada Business Corporations Act and based in Toronto. *Seabridge Gold Incorporated*, SYSTEM FOR ELECTRONIC DOCUMENT ANALYSIS AND RETRIEVAL, <https://www.sedar.com/DisplayProfile.do?lang=EN&issuerType=03&issuerNo=00007531>.

²³⁰ Seabridge, Featured Projects: KSM, <http://seabridgegold.net/projects.php>; Seabridge Gold, Backgrounder, http://seabridgegold.net/pdf/KSM_fact_sheet.pdf.

²³¹ Seabridge, KSM EA Application, *supra* note 18; *see also id.* Fig. 4.1-1 (showing the Mine Site and other parts of the KSM project relative to the Unuk River).

²³² *Id.* at 4-5.

²³³ *Id.* at 4-21.

²³⁴ *Id.* at 4-5.

²³⁵ *Id.*

²³⁶ *Id.* at 4-22 (“[T]he majority of the KSM Project rock is potentially acid-generating (PAG), particularly in the vicinity of the ore deposits. Substantial volumes of non-ore (waste) PAG rock must be mined in order to access the ore.”).

²³⁷ Seabridge, KSM Mine Project Environmental Effects Summary at 1 (July 2013) (KSM Environmental Effects Summary) (“Mined waste rock will be stored in rock storage facilities (RFSs) in the Mitchell and McTagg creek valleys and placed as backfill in the mined-out Sulphurets Pit.”).

²³⁸ KSM EA Application, *supra* note 18, at 4-137. The water storage facility will also receive effluent from a selenium treatment plant that will treat the selenium contaminated water that has been exposed to the waste rock from the Kerr Pit. *Id.* at 4-158.

²³⁹ *Id.* at 4-137.

²⁴⁰ *Id.* at 4-149.

²⁴¹ *Id.*

²⁴² Canadian Environmental Assessment Agency, KSM (Kerr-Sulphurets-Mitchell) Project: Comprehensive Study Report at 8 (July 2014), http://ksmproject.com/wp-content/uploads/2014/07/34-081-CEAA_KSM_EN_R4_X4.pdf.

²⁴³ Chambers Report, *supra* note 59, ¶¶ 57-58.

²⁴⁴ *Id.*

²⁴⁵ *Id.*, ¶ 65.

²⁴⁶ See British Columbia Ministry of Environment and Ministry of Energy and Mines, Environmental Assessment Certificate #M14-01 (July 29, 2014), <https://projects.eao.gov.bc.ca/p/ksm/docs>.

²⁴⁷ Chambers Report, *supra* note 59, ¶ 67.

²⁴⁸ *Id.*, ¶ 59; Zamzow Assessment, *supra* note 83, at 1. Baseline mean concentrations for metals analyzed in this petition were as follows: aluminum: 24.3 ug/L in November-April, 57 ug/L in May-October; cadmium 0.1924.3 ug/L in November-April, 191 ug/L in May-October; copper: 1.95 ug/L in November-April, 2.64 ug/L in May-October; selenium: 0.88 ug/L in November-April, 12.5 ug/L in May-October; zinc: 8.4 ug/L in November-April, 4.9 ug/L in May-October. KSM EA Application, *supra* note 18, Tbl. 14.1-1.

²⁴⁹ Seabridge Gold Inc., KSM Mine Project Environmental Effects Summary, *supra* note 237, at 13.

²⁵⁰ *Id.*

²⁵¹ Zamzow Assessment, *supra* note 83, at 2, 10.

²⁵² See section IV.B.1.

²⁵³ Chambers Report, *supra* note 59, ¶¶ 31-33; Zamzow Assessment, *supra* note 83, at 9-10.

²⁵⁴ Zamzow Assessment, *supra* note 83, at 3-4.

²⁵⁵ *Id.*

²⁵⁶ *Id.* at 3.

²⁵⁷ *Id.* at 3-4.

²⁵⁸ *Id.* This was based on the 85th percentile concentration, which is what the State of Alaska looks at when evaluating water quality discharge permits. *Id.*

²⁵⁹ *Id.* at 4.

²⁶⁰ *Id.* at 1, 5-10.

²⁶¹ *Id.* at 2, 7-8.

²⁶² *Id.* at 8.

²⁶³ *Id.* at 9-10.

²⁶⁴ *Id.*

²⁶⁵ *Id.* at 10.

²⁶⁶ Chambers Report, *supra* note 59, ¶¶ 60-65.

²⁶⁷ See *infra* section IV.B.5.

²⁶⁸ Chambers Report, *supra* note 59, ¶ 66.

²⁶⁹ *Id.*, ¶ 59; Zamzow Assessment, *supra* note 83, at 1.

²⁷⁰ Report of Sarah O’Neal, ¶¶ 1-2 (Nov. 13, 2018) (O’Neal Report), attached here as Appendix 3.

²⁷¹ *Id.*, ¶¶ 54, 100.

²⁷² *Id.*, ¶ 100.

²⁷³ *Id.*, ¶ 51. Toxicological studies have established these concentrations in laboratories, but in the field, variability in factors that contribute to toxic effects, such as alkalinity, dissolved organic carbon, and temperature make the effects of particular concentrations difficult to predict with precision. *Id.*, ¶ 53. In the absence of comprehensive knowledge about each of these variables at a given location, it is not possible to predict exactly what toxicological effects would result from a given concentration of a metal. *Id.*

²⁷⁴ *Id.*, ¶¶ 54, 103.

²⁷⁵ *Id.*, ¶ 87.

²⁷⁶ *Id.*

²⁷⁷ *Id.*

²⁷⁸ *Id.*

²⁷⁹ *Id.*, ¶¶ 87-88.

²⁸⁰ *Id.*, ¶ 90.

²⁸¹ *Id.*, ¶ 91.

²⁸² *Id.*, ¶ 76.

²⁸³ *Id.*

²⁸⁴ *Id.*

²⁸⁵ *Id.*, ¶ 77.

²⁸⁶ *Id.*, ¶ 78.

²⁸⁷ *Id.*

²⁸⁸ *Id.*

²⁸⁹ *Id.*

²⁹⁰ *Id.*, ¶ 79.

²⁹¹ *Id.*

²⁹² *Id.*

²⁹³ *Id.*, ¶ 80.

²⁹⁴ *Id.*

²⁹⁵ *Id.*

²⁹⁶ *Id.*

²⁹⁷ *Id.*, ¶ 81.

²⁹⁸ *Id.*

²⁹⁹ *Id.*

³⁰⁰ *Id.*, ¶ 82.

³⁰¹ *Id.*, ¶ 83.

³⁰² *Id.*, ¶ 57.

³⁰³ *Id.*

³⁰⁴ *Id.*

³⁰⁵ *Id.*, ¶ 58.

³⁰⁶ *Id.*, ¶¶ 9, 58.

³⁰⁷ *Id.*, ¶ 58.

³⁰⁸ *Id.*

³⁰⁹ *Id.*

³¹⁰ *Id.*

³¹¹ *Id.*, ¶ 59.

³¹² *Id.*

³¹³ *Id.*

³¹⁴ *Id.*, ¶ 60.

³¹⁵ *Id.*, ¶ 62.

³¹⁶ *Id.*, ¶ 65.

³¹⁷ *Id.*

³¹⁸ *Id.*, ¶ 66.

³¹⁹ *Id.*, ¶ 67.

³²⁰ *Id.*, ¶ 68.

³²¹ *Id.*, ¶ 69.

³²² *Id.*

³²³ *Id.*, ¶ 70.

³²⁴ *Id.*

³²⁵ *Id.*, ¶ 71.

³²⁶ *Id.*

³²⁷ *Id.*

³²⁸ *Id.*, ¶ 74.

³²⁹ *Id.*, ¶ 93.

³³⁰ *Id.*, ¶ 94.

³³¹ *Id.*

³³² *Id.*

³³³ *Id.*, ¶ 95.

³³⁴ *Id.*

³³⁵ *Id.*

³³⁶ *Id.*, ¶ 96.

³³⁷ *Id.*, ¶ 97.

³³⁸ *Id.*, ¶ 98.

³³⁹ *Id.*, ¶ 99.

³⁴⁰ *Id.*, ¶ 101.

³⁴¹ *Id.*

³⁴² *Id.*, ¶ 103.

³⁴³ *Id.*

³⁴⁴ See section IV.B.2.

³⁴⁵ See section IV.B.3.

³⁴⁶ *Id.*

³⁴⁷ Inter-Am. Ct. H.R., *Advisory Opinion OC-10/89, Interpretation of the American Declaration of the Rights and Duties of Man Within the Framework of Article 64 of the American Convention on Human Rights*, 1989 Inter-Am. Ct. H.R. (ser. A) No. 10, ¶ 42 (July 14, 1989) (Inter-Am. Ct. H.R., *Interpretation of the American Declaration*).

³⁴⁸ *Grand Chief Michael Mitchell v. Canada*, Case 12.435, Inter-Am. C.H.R., Report No. 61/08, OEA/Ser.L/V/II.118, doc. 70 rev. 2, ¶ 64 (Jul. 25, 2008) (*Grand Chief Michael Mitchell v. Canada*); *Mary and Carrie Dann v. United States*, Case 11.140, Inter-Am. C.H.R., Report No. 75/02, ¶ 97 (2002) (*Dann*); *Maya Indigenous Communities of the Toledo District v. Belize*, Case 12.053, Inter-Am. C.H.R. Report No. 40/04, OEA/Ser.L/V/II.122, doc. 5 rev. 1, ¶ 87 (2004) (*Belize Maya*).

³⁴⁹ Organization of American States, American Convention on Human Rights, Nov. 22, 1969, O.A.S.T.S. No. 36, 1144 U.N.T.S. 123 (American Convention), art. 29; see also Inter-Am. Ct. H.R., *Interpretation of the American Declaration*, *supra* note 347, ¶ 42.

³⁵⁰ *Grand Chief Michael Mitchell v. Canada*, *supra* note 348, ¶ 63 (citing Inter-Am. Ct. H.R., *Interpretation of the American Declaration*, *supra* note 347, ¶ 37).

³⁵¹ Inter-Am. Ct. H.R., *Advisory Opinion OC-23/17, Human Rights and the Environment*, ¶ 44 (15 November 2017) (Inter-Am. Ct. H.R., *Human Rights and the Environment*). (“[L]a Corte desea subrayar que, aunque no le corresponde emitir una interpretación directa de los distintos instrumentos de derecho ambiental, indudablemente los principios, derechos y obligaciones allí contenidos contribuyen en forma decisiva a fijar el alcance de la Convención Americana.” (“[T]he Court wishes to emphasize that, although it is not issuing a direct interpretation of the various instruments of environmental law, undoubtedly the principles, rights and obligations contained therein contribute decisively to establishing the scope of the American Convention”)) (*translation by the authors*).

³⁵² *Id.* (“En virtud de la materia sometida a consulta, la Corte tendrá en consideración, como fuentes de derecho internacional adicionales, otras convenciones relevantes a fin de efectuar una interpretación armónica de las obligaciones internacionales en los términos de la disposición citada. En adición, la Corte considerará las obligaciones aplicables y la jurisprudencia y decisiones al respecto, así como las resoluciones, pronunciamientos y declaraciones referentes al tema que hubieren sido adoptados a nivel internacional.” (“By virtue of the matter submitted for consultation, the Court will take into consideration, as sources of additional international law, other relevant conventions in order to have a harmonious interpretation of international obligations in the terms of the aforementioned provision. In addition, the Court will consider the applicable obligations and the jurisprudence and decisions in this

regard, as well as the resolutions, pronouncements and statements referring to the topic that have been adopted at the international level.”)) (*translation by the authors*).

³⁵³ *Id.*, ¶ 130.

³⁵⁴ See, e.g., Additional Protocol to the American Convention on Human Rights in the Area of Economic Social and Cultural Rights (Protocol of San Salvador), art. 11, Nov. 14, 1988, O.A.S.T.S. No. 69, 28 I.L.M. 156; Organization of African Unity, African Charter on Human and Peoples’ Rights, art. 24, June 1981, OAU Doc. CAB/LEG/67/3 rev. 5, 21 I.L.M. 58 (entered into force Oct. 21, 1986) (African Charter).

³⁵⁵ Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 46.

³⁵⁶ *Id.*, ¶ 47, citing Cfr. *Case of Kawas Fernández Vs. Honduras*, 2009 Inter-Am. Ct. H.R. (ser C) No. 196 (Apr. 3, 2009), ¶ 148. The Court also referred to other regional human rights bodies and courts, UN treaty bodies, and UN Special Rapporteurs, among other sources. See generally *id.*, ¶¶ 46-70.

³⁵⁷ *Id.*, ¶¶ 64, 66.

³⁵⁸ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights over their Ancestral Lands and Natural Resources: Norms and Jurisprudence of the Inter-American Human Rights System* (Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*) (Dec. 30, 2009), ¶ 190. The Commission has referred to numerous international instruments’ recognition of the duty to protect the environment. See, e.g., International Covenant on Economic, Social and Cultural Rights (ICESCR), art. 1(2), Dec. 16, 1966, 6 I.L.M. 360, 365, 993 U.N.T.S. 3 (signed by Canada on May 19, 1976); Convention on the Rights of the Child, arts. 24, 27, and 30, Nov. 20, 1989, 28 I.L.M. 1448, 1577 U.N.T.S. 3 (ratified by Canada on Dec. 13, 1991); Protocol of San Salvador, *supra* note 354, art. 11; African Charter, *supra* note 354, art. 23 (“[a]ll peoples shall have the right to a generally satisfactory environment favorable to their development.”); Organization of African Unity, African Charter on the Rights and Welfare of the Child, July 1990, art. 14, OAU Doc. CAB/LEG/24.9/49 (entered into force Nov. 29, 1999) (“to ensure the provision of...safe drinking water.”); Final Draft Charter of Fundamental Rights of the European Union, Sept. 28, 2000, art. 37, 2000 O.J. (C 364) 1, 17 (“A high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development.”); Convention on Biological Diversity, pmb. (June 5, 1992), 31 I.L.M. 818, 1760 U.N.T.S. 79 (entered into force Dec. 29, 1993); G.A. Res. 45/94, ¶ 1, U.N. GAOR, 45th Sess., U.N. Doc. A/45/749 (1990) (“all individuals are entitled to live in an environment adequate for their health and well-being”); G.A. Res. 55/107, ¶ 3(k), U.N. GAOR, 55th Sess., U.N. Doc. A/RES/55/107 (2000) (“affirm[ing] that a democratic and equitable international order requires, inter alia, the realization of ... the entitlement of every person and all peoples to a healthy environment”); UN Office of the High Commissioner for Human Rights, ¶ 3(k), CHR Res. 2000/62, U.N. ESCOR, 56th Sess., U.N. Doc. E/CN.4/RES/2000/62 (2000) (“a democratic and equitable international order requires, inter alia, the realization of ... [t]he right to a healthy environment for everyone.”).

³⁵⁹ Inter-Am. C.H.R., *Report on the Human Rights Situation in Ecuador* (Inter-Am. C.H.R., *Ecuador Report*), OEA/Ser.L/V/II.96, Doc. 10 rev. 1 (24 April 1997), ch. IX.

³⁶⁰ Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 125. Other obligations that the Court specified related to environmental protection include the obligation of cooperation and procedural obligations.

³⁶¹ *Id.*, ¶ 127.

³⁶² *Id.*, ¶ 130 (“Tomando en cuenta que frecuentemente no es posible restaurar la situación existente antes de la ocurrencia de un daño ambiental, la prevención debe ser la política principal respecto a la protección del medio ambiente.”) (“Taking into account that it is often not possible to restore the

existing situation before the occurrence of environmental damage, prevention must be the main policy regarding the protection of the environment”)) (*translation by the authors*).

³⁶³ See generally *id.*, ¶¶ 127-140.

³⁶⁴ *Id.*, ¶ 142.

³⁶⁵ *Id.*, ¶¶ 142, 145-169.

³⁶⁶ *Id.*, ¶¶ 133, 140.

³⁶⁷ Inter-Am. C.H.R., *Ecuador Report*, *supra* note 359, ch. VIII. The Commission further noted, “the absence of regulation, inappropriate regulation, or a lack of supervision in the application of extant norms may create serious problems with respect to the environment which translate into violations of human rights protected by the American Convention [on Human Rights].” *Id.*, ch. VIII.

³⁶⁸ *Belize Maya*, *supra* note 348, ¶ 150.

³⁶⁹ Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 180 (“Por tanto, esta Corte entiende que, los Estados deben actuar conforme al principio de precaución, a efectos de la protección del derecho a la vida y a la integridad personal, en casos donde haya indicadores plausibles que una actividad podría acarrear daños graves e irreversibles al medio ambiente, aún en ausencia de certeza científica. Por tanto, los Estados deben actuar con la debida cautela para prevenir el posible daño.” (“Therefore, this Court understands that States must act in accordance with the precautionary principle, for the purposes of protecting the right to life and personal integrity, in cases where there are plausible indicators that an activity could cause serious and irreversible harms to the environment, even in the absence of scientific certainty. Therefore, States must act with due caution to prevent possible harm.”)) (*translation by the authors*).

³⁷⁰ *Id.*

³⁷¹ Canadian Environmental Protection Act, 1999 SC, ch. 33 (Can.), pmb.

³⁷² *Id.*, ¶ 2(1)(a).

³⁷³ See *114957 Canada Ltée (Spraytech, Société d’arrosage) v. Hudson (Town)*, [2001] 2 SCR 241.

³⁷⁴ See, e.g., UN Framework Convention on Climate Change, art. 3.3, May 9, 1992, 31 I.L.M. 849 (ratified by Canada on Dec. 4, 1992) (“The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects;” “lack of full scientific certainty should not be used as a reason for postponing [cost-effective] measures” in the face of “threats of serious or irreversible damage”); Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals, pmb., ¶¶ 2-3, June 24, 1998, U.N. Doc. E/ECE/EB.AIR/66/1999, U.N. Sales No. E.99.II.E.21 (1999); Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, arts. 5-6, Annex II, U.N. Doc. A/CONF.164/37 (Aug. 4, 1995) (ratified by Canada on Aug. 3, 1999).

³⁷⁵ OAS General Assembly, American Declaration on the Rights of Indigenous Peoples, AG/RES.2888 (XLVI-O/16) (June 15, 2016) (American Declaration on the Rights of Indigenous Peoples) (emphasis added).

³⁷⁶ See *id.*, art. XXVIII (“The rights of man are limited by the rights of others, by the security of all, and by the just demands of the general welfare and the advancement of democracy.”).

³⁷⁷ See, e.g., International Covenant on Civil and Political Rights, art. 2.1, Dec. 16, 1966, 6 I.L.M. 368, 999 U.N.T.S. 171 (acceded to by Canada on May 19, 1976) (ICCPR).

³⁷⁸ American Convention, *supra* note 349, art. 11.

³⁷⁹ Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 102 (*translation by the authors*) (“El ejercicio de la jurisdicción por parte del Estado de origen frente a daños transfronterizos se basa en el entendimiento de que es el Estado, en cuyo territorio o bajo cuya jurisdicción se realizan estas actividades, quien tiene el control efectivo sobre las mismas y está en posición de impedir que se cause un daño transfronterizo que afecte el disfrute de los derechos humanos de individuos fuera de su territorio.”). The Court defines “State of origin” as the State under whose jurisdiction or control an incident occurs or could occur which causes environmental harm. *Id.*, n.195.

³⁸⁰ *Id.*, ¶ 104.g. (*translation by the authors*) (“Los Estados están obligados a adoptar todas las medidas necesarias para evitar que las actividades desarrolladas en su territorio o bajo su control afecten los derechos de las personas dentro o fuera de su territorio.”).

³⁸¹ *Id.*, ¶¶ 142, 145-169.

³⁸² Human Rights Committee, Concluding observations on the sixth periodic report of Canada, CCPR/C/CAN/CO/6 (13 August 2015) (The Committee stated its concern: “about allegations of human rights abuses by Canadian companies operating abroad, in particular mining corporations, and about the inaccessibility to remedies by victims of such violations. The Committee regrets the absence of an effective independent mechanism with powers to investigate complaints alleging abuses by such corporations that adversely affect the enjoyment of the human rights of victims, and of a legal framework that would facilitate such complaints (art. 2).”). The Human Rights Committee has addressed the extra-territorial obligations of other states as well in the context of their surveillance of communications outside of their territories. See Human Rights Committee, Concluding observations on the fourth report of the United States of America, CCPR/C/USA/CO/4, para. 22 (23 April 2014); Human Rights Committee, Concluding observations on the fifth periodic report of France, CCPR/C/FRA/CO/5, para. 12 (16 August 2015); Human Rights Committee, Concluding observations Concluding observations on the seventh periodic report of the United Kingdom of Great Britain and Northern Ireland, CCPR/C/GBR/CO/7 (16 August 2015).

³⁸³ Article 6 of the International Convention on the Elimination of All Forms of Racial Discrimination (ICERD) provides: “States Parties shall assure to everyone within their jurisdiction effective protection and remedies, through the competent national tribunals and other State institutions, against any acts of racial discrimination which violate his human rights and fundamental freedoms contrary to this Convention, as well as the right to seek from such tribunals just and adequate reparation or satisfaction for any damage suffered as a result of such discrimination.” ICERD, Dec. 1 1965, 660 U.N.T.S. 195 (ratified by Canada on Oct. 14, 1970).

³⁸⁴ CERD, Concluding Observations on Canada, CERD/C/CAN/CO/18, ¶ 17 (25 May 2007); see also CERD, Concluding observations on Australia, CERD/C/AUS/CO/15-17, ¶ 13 (27 August 2010), (encouraging Australia to “take appropriate legislative or administrative measures to prevent acts of Australian corporations which negatively impact on the enjoyment of rights of indigenous peoples domestically and overseas and to regulate the extra-territorial activities of Australian corporations abroad. The Committee also encourages the State party to fulfil its commitments under the different international initiatives it supports to advance responsible corporate citizenship.”).

³⁸⁵ CERD, Concluding Observations: United Kingdom of Great Britain and Northern Ireland, CERD/C/GBR/CO/18–20, ¶ 29 (14 September 2011); see also CERD, Concluding Observations: United States, CERD/C/USA/CO/6, ¶ 30 (8 May 2008) (“the Committee encourages the State party to take appropriate legislative or administrative measures to prevent acts of transnational corporations registered in the State party which negatively impact on the enjoyment of rights of indigenous peoples in territories outside the United States. In CERD/C/USA/CO/6 page 11 particular, the Committee

recommends that the State party explore ways to hold transnational corporations registered in the United States accountable.”).

³⁸⁶ Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 102.

³⁸⁷ See, e.g., *id.*, ¶ 47.

³⁸⁸ See, e.g., *Xákmok Kásek Indigenous Community v. Paraguay*, Inter-Am. Ct. H.R. (ser. C) No. 214, ¶ 291 (Aug. 24, 2010) (*Xákmok*); *Case of the Saramaka People v. Suriname*, 2007 Inter-Am. Ct. H.R. (ser. C) No. 172 (Nov. 28, 2007) (*Saramaka*); *Case of the Sawhoyamaxa Indigenous Community v. Paraguay*, 2006 Inter-Am. Ct. H.R. (ser. C) No. 146 (Mar. 29, 2006) (*Sawhoyamaxa*); *Case of the Yakyé Axa Indigenous Community v. Paraguay*, 2005 Inter-Am. Ct. H.R. (ser. C) No. 125 (June 17, 2005) (*Yakyé Axa*); *Mayagna (Sumo) Awas Tingni Community v. Nicaragua, Merits, Reparations and Costs, Judgment*, Inter-Am. Ct. H.R. (ser. C) No. 79, ¶ 149 (Aug. 31, 2001) (*Awas Tingni*). See also Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 48.

³⁸⁹ Inter-Am. C.H.R., *Ecuador Report*, *supra* note 359, ch. IX (internal citation omitted).

³⁹⁰ Inter-Am. C.H.R., *Indigenous Peoples, Afro-Descendent Communities, and Natural Resources: Human Rights Protection in the Context of Extraction, Exploitation, and Development Activities*, OEA/Ser.L/V/II. Doc.47/15 (*Extractive Industries and Indigenous Peoples’ Rights Report*), at 10.

³⁹¹ See, e.g., *Awas Tingni*, *supra* note 388; *Yakyé Axa*, *supra* note 388; *Xákmok*, *supra* note 388 (Inter-American Court cases); *Dann*, *supra* note 348, ¶ 125; *Belize Maya*, *supra* note 348, ¶ 95; *Case of Yanomami Indians v. Brazil*, Case 7615, Inter-Am. C.H.R., OEA/Ser.L/V/II.66, doc. 10 rev. 1, ¶¶ 7-8 (1985) (*Yanomami*).

³⁹² See, e.g., *Dann*, *supra* note 348, ¶ 126 (“[T]he Commission has since its establishment in 1959 recognized and promoted respect for the rights of indigenous peoples of this Hemisphere.”).

³⁹³ See, e.g., *Awas Tingni*, *supra* note 388, ¶ 151 (American Convention’s protection of “property” means protection of property rights as understood by the indigenous community involved); *Case of Aloeboetoe v. Suriname, Reparations*, 1993 Inter-Am. Ct. H.R. (ser. C) No. 15, ¶ 58 (Sept. 10, 1993) (disregarding the State’s domestic family law for purposes of determining which persons were the next-of-kin of the victims and awarding reparations based on the matrilineal and polygamist customs of the Saramaka people to which the victims belonged).

³⁹⁴ See, e.g., *Yanomami*, *supra* note 391, ¶ (“[I]nternational law in its present state … recognizes the right of ethnic groups to special protection … for all those characteristics necessary for the preservation of their cultural identity.”).

³⁹⁵ See *Dann*, *supra* note 348, ¶ 125 (citing Inter-Am. C.H.R., *The Human Rights Situation of the Indigenous People in the Americas*, OEA/Ser.L/V/II.108, Doc. 62 (2000), at 21-25); see also *Belize Maya*, *supra* note 348, ¶ 95 (citing same).

³⁹⁶ *Xákmok*, *supra* note 388, ¶ 174; see also *Sawhoyamaxa*, *supra* note 388, ¶ 118; *Yakyé Axa*, *supra* note 388, ¶ 135.

³⁹⁷ *Saramaka*, *supra* note 388, ¶ 85; see also *Case of the Moiwana Community v. Suriname*, 2005 Inter-Am. Ct. H.R. (ser. C) No. 124 (June 15, 2005) (*Moiwana*), ¶ 133.

³⁹⁸ *Yakyé Axa*, *supra* note 388, ¶ 124; see also *Xákmok*, *supra* note 388, ¶ 321 (special meaning of land for indigenous peoples “means that all denial of the enjoyment or exercise of land rights does damage to values that are very important for those peoples, as they experience the risk of losing their identities and cultural heritage that they would pass on to future generations, or of experiencing damage that would be irreparable within their lifetimes”); *Saramaka*, *supra* note 388, ¶ 86.

³⁹⁹ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XIX(1).

⁴⁰⁰ *Id.*, art. XIX(3).

⁴⁰¹ James Anaya, *The Situation of Indigenous Peoples in Canada*, U.N. Doc. A/HRC/27/52/Add.2 (4 July 2014) (*Anaya Canada Report*), ¶ 69.

⁴⁰² Organization of American States, *American Declaration of the Rights and Duties of Man*, O.A.S. Res. XXX (1948), reprinted in Basic Documents Pertaining to Human Rights in the Inter-American System, OAS/Ser.L/V/1.4 Rev. 9 (2003) (American Declaration), art. XIII (“Every person has the right to take part in the cultural life of the community, to enjoy the arts, and to participate in the benefits that result from intellectual progress, especially scientific discoveries.”).

⁴⁰³ Protocol of San Salvador, *supra* note 354, art. 14, Nov. 14, 1988, O.A.S.T.S. No. 69, 28 I.L.M. 156.

⁴⁰⁴ Universal Declaration of Human Rights, G.A. Res. 217A, at 72, U.N. GAOR, 3rd Sess., 1st plen. mtg., U.N. Doc. A/810 (Dec. 12, 1948), art. 27.1. (“Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.”).

⁴⁰⁵ ICCPR, *supra* note 377, art. 27 (Members of minority groups “shall not be denied the right, in community with other members of their group, to enjoy their own culture, to profess and practice[sic] their own religion, or to use their own language.”).

⁴⁰⁶ ICERD, *supra* note 383, art. 7; see, also, UN Committee on the Elimination of Racial Discrimination, *General Recommendation No. 23, Annex V: Rights of indigenous peoples*, at 122, ¶ 4(e), U.N. Doc. A/52/18 (Aug. 18, 1997).

⁴⁰⁷ ICESCR, *supra* note 358, art. 15(1) (“The States Parties to the present Covenant recognize the right of everyone[] [t]o take part in cultural life.”).

⁴⁰⁸ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XIII(1).

⁴⁰⁹ *Awas Tingni*, *supra* note 388, ¶ 149.

⁴¹⁰ See generally Inter-Am. Ct. H.R., *Human Rights and the Environment*, *supra* note 351, ¶ 48.

⁴¹¹ *Moiwana*, *supra* note 397, ¶ 101.

⁴¹² *Yakye Axa*, *supra* note 388, ¶ 154.

⁴¹³ *Sawhoyamaxa*, *supra* note 388, ¶ 131; see also *Xákmok*, *supra* note 388, ¶ 113.

⁴¹⁴ *Saramaka* is a separate case from *Aloeboetoe*, cited *supra*, which also involved the Saramaka people.

⁴¹⁵ *Saramaka*, *supra* note 388, ¶¶ 90, 86.

⁴¹⁶ *Chitay Nech v. Guatemala Case*, Inter-Am. Ct. H.R. (ser. C) No. 212, ¶ 147 (May 25, 2010).

⁴¹⁷ See *Belize Maya*, *supra* note 348, ¶¶ 154-155.

⁴¹⁸ *Id.*, ¶ 154.

⁴¹⁹ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 56.

⁴²⁰ *Id.*, ¶ 78.

⁴²¹ *Id.*, ¶ 74 (citing UN Office of the High Commissioner for Human Rights, General Comment No. 23: The Rights of Minorities (art. 27), ¶ 6.2, CCPR/C/21/Rev.1/Add.5 (Apr. 8, 1994) (OHCHR, Gen. Comment No. 23), ¶ 7); see also *Dann*, *supra* note 348, ¶ 130, n.97 (same).

⁴²² See, e.g., Inter-Am. C.H.R., *Ecuador Report*, *supra* note 359, ch. IX (“Certain indigenous peoples maintain special ties with their traditional lands, and a close dependence upon the natural resources provided therein – respect for which is essential to their physical and cultural survival.”) (citation

omitted); Inter-Am. C.H.R., *Extractive Industries and indigenous peoples' rights report*, *supra* note 390; Inter-Am. C.H.R., *Report on the Situation of Human Rights of a Segment of the Nicaraguan Population of Miskito Origin*, OEA/Ser.L/V/II.62, Doc. 10 rev. 3 81 Part II (1983), ¶ II.B.15 (“[S]pecial legal protection is recognized for the use of their language, the observance of their religion, and in general, all those aspects related to the preservation of their cultural identity. To this should be added the aspects linked to productive organization, which includes, among other things, the issue of the ancestral and communal lands. Non-observance of those rights and cultural values leads to a forced assimilation with results that can be disastrous.”).

⁴²³ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XXV(1).

⁴²⁴ *Id.*, art. XIII(1).

⁴²⁵ See, e.g., *Centre for Minority Rights Development v. Kenya*, Case 276/2003, Afr. Comm'n on Human and Peoples' Rights, ¶ 156 (2009) (citing extensively the Inter-American Court's jurisprudence in *Awas Tingni*, *Moiwana*, and *Saramaka* in observing that indigenous peoples' “culture, religion, and traditional way of life are intimately intertwined with their ancestral lands [] and the surrounding area” and that “without access to their ancestral land, [they] are unable to fully exercise their cultural and religious rights, and feel disconnected from their land and ancestors.”).

⁴²⁶ *Belize Maya*, *supra* note 348, ¶ 141.

⁴²⁷ UN Human Rights Committee, *Bernard Ominayak and the Lubicon Lake Band v. Canada*, Communication No. 167/1984, U.N. Doc. CCPR/C/38/D/167/1984 (Mar. 26, 1990) (*Lubicon Lake Band*).

⁴²⁸ *Id.*; see also UN Human Rights Committee, *Apirana Mahuika et al. v. New Zealand*, Communication No. 547/1993, ¶ 9.5, U.N. Doc. CCPR/C/70/D/547/1993 (Nov. 16, 2000) (noting that, according to general comment to Article 27, “especially in the case of indigenous peoples, the enjoyment of the right to one's own culture may require positive legal measures of protection by a State party and measures to ensure the effective participation of members of minority communities in decisions which affect them.”).

⁴²⁹ *Lubicon Lake Band*, *supra* note 427, ¶ 33.

⁴³⁰ OHCHR, Gen. Comment No. 23, *supra* note 421, ¶¶ 7, 9.

⁴³¹ UN Human Rights Committee, *Ilmari Länsman v. Finland*, Communication No. 511/1992, ¶ 9.3, U.N. Doc. CCPR/C/52/D/511/1992 (Nov. 8, 1994).

⁴³² UN Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 21, *Right of everyone to take part in cultural life*, (art. 15, para. 1 (a), of the International Covenant on Economic, Social and Cultural Rights), ¶ 36, E/C.12/GC/21 (Dec. 21, 2009) (CESCR, Gen. Comment No. 21) (citing International Labour Organization, Convention concerning Indigenous and Tribal Peoples in Independent Countries, June 27, 1989, arts. 13-16). See also United Nations Declaration on the Rights of Indigenous Peoples, G.A. Res. 61/295, pmbl., U.N. Doc. A/RES/61/295 (Sept. 13, 2007) (UNDRIP), arts. 20 and 33. The Committee added that “States parties must take measures to recognize and protect the rights of indigenous peoples to own, develop, control and use their communal lands, territories and resources.” CESCR, Gen. Comment No. 21, ¶ 36.

⁴³³ UNDRIP, *supra* note 432, art. 8.

⁴³⁴ *Id.*, art. 13.

⁴³⁵ See section IV.A.

⁴³⁶ See *Yakye Axa*, *supra* note 388, ¶ 135; *Xákmok*, *supra* note 388, ¶ 174; see also *Sawhoyamaxa*, *supra* note 388, ¶ 118; OHCHR, Gen. Comment No. 23, *supra* note 421, ¶ 7.

⁴³⁷ *Saramaka*, *supra* note 388, ¶¶ 90, 86.

⁴³⁸ ICESCR, *supra* note 358, art. 1(2); ICCPR, *supra* note 377, art. 1(2).

⁴³⁹ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, arts. XXIX(1) and XIX(4).

⁴⁴⁰ UNDRIP, *supra* note 432, art. 20.

⁴⁴¹ *Xákmok*, *supra* note 388, ¶ 174; *see also* *Yakyé Axa*, *supra* note 388, ¶ 135.

⁴⁴² *Xákmok*, *supra* note 388, ¶¶ 180, 282.

⁴⁴³ *Id.*

⁴⁴⁴ Inter-Am. C.H.R., *Indigenous and Tribal Peoples' Rights*, *supra* note 358, ¶ 56 (citing *Dann*, *supra* note 348, ¶ 128 (noting connection between subsistence and the right to property, stating that the American Convention's right to property "refers ... [to] its capacity for providing the resources which sustain life")).

⁴⁴⁵ *Yakyé Axa*, *supra* note 388, ¶ 168.

⁴⁴⁶ *Id.*, ¶ 164.

⁴⁴⁷ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XXIX(5).

⁴⁴⁸ *See* section IV.A.

⁴⁴⁹ Inter-Am. C.H.R., *Indigenous and Tribal Peoples' Rights*, *supra* note 358, ¶ 56 (citing *Dann*, *supra* note 348, ¶ 128 (noting connection between subsistence and the right to property, stating that the American Convention's right to property "refers ... [to] its capacity for providing the resources which sustain life")).

⁴⁵⁰ American Declaration, *supra* note 402, art. XI.

⁴⁵¹ Protocol of San Salvador, *supra* note 354, art. 10.

⁴⁵² Article 25(1) of the Universal Declaration of Human Rights, *supra* note 404, assures the right to "a standard of living adequate for the health and well-being of himself and his family, including...medical care and necessary social services."

⁴⁵³ Pursuant to Article 12 of the ICESCR, *supra*, note 358: "1. The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health. 2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for: ... (b) the improvement of all aspects of environmental and industrial hygiene; (c) the prevention, treatment and control of epidemic ... and other diseases."

⁴⁵⁴ African Charter, *supra* note 354, art. 16 ("Every individual shall have the right to enjoy the best attainable state of physical and mental health.").

⁴⁵⁵ UN Office of the High Commissioner for Human Rights, World Health Organization, *The Right to Health: Fact Sheet No. 31* at 10 (June 2008).

⁴⁵⁶ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XVIII(1).

⁴⁵⁷ *Yanomami*, *supra* note 391, ¶ 10(b).

⁴⁵⁸ *Id.* "Resolves" ¶ 1. Though the facts in that case demonstrated an extreme circumstance, the case affirmed the principle of state responsibility for violations of indigenous peoples' human rights under the Inter-American system.

⁴⁵⁹ *Belize Maya*, *supra* note 348, ¶¶ 154-156.

⁴⁶⁰ Inter-Am. C.H.R., *Ecuador Report*, *supra* note 359, ch. IX (internal citation omitted).

⁴⁶¹ *Id.*, ch. VIII.

⁴⁶² UN Committee on Economic, Social and Cultural Rights, *Substantive Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights*, General Comment No. 14, ¶ 4, U.N. Doc. E/C.12/2000/4 (Aug. 11, 2000).

⁴⁶³ *Id.*, ¶ 59.

⁴⁶⁴ Section IV.A.2.

⁴⁶⁵ ICESCR, *General Comment 14*, *supra* note 462, ¶ 57.

⁴⁶⁶ American Declaration, *supra* note 402, art. XXIII.

⁴⁶⁷ American Convention, *supra* note 349, art. 21.

⁴⁶⁸ *Annual Report of the Inter-American Commission on Human Rights*, Inter-Am. C.H.R., OEA/Ser.L/V/II.85, doc. 9 rev. ch. IV, ¶ VII(A) (1994) (Nicaragua, Right to Property).

⁴⁶⁹ Universal Declaration of Human Rights, *supra* note 404, art. 17.

⁴⁷⁰ Council of Europe, Protocol [1] to the Convention for the Protection of Human Rights and Fundamental Freedoms, art. 1, Nov. 4, 1950, 213 U.N.T.S. 221 (“Every natural or legal person is entitled to the peaceful enjoyment of his possessions. No one shall be deprived of his possessions except in the public interest and subject to the conditions provided for by law and by the general principle of international law.”).

⁴⁷¹ African Charter, *supra* note 354, art. 14 (“The right to property shall be guaranteed. It may only be encroached upon in the interest of public need or in the general interest of the community and in accordance with the provisions of appropriate laws.”).

⁴⁷² American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XXV(2). See also, e.g., *Xákmok*, *supra* note 388, ¶¶ 108-09; *Moiwana*, *supra* note 397, ¶ 133; *Yakye Axa*, *supra* note 388, ¶¶ 131, 135, 137; *Sawhoyamaxa*, *supra* note 388, ¶¶ 127, 131; *Awas Tingni*, *supra* note 388, ¶ 149. This right “extend[s] in principle over all of those lands and resources that indigenous peoples currently use, and over those lands and resources that they possessed and of which they were deprived, with which they preserve their internationally protected special relationship – i.e. a cultural bond of collective memory and awareness of their rights of access or ownership, in accordance with their own cultural and spiritual rules.” Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 78.

⁴⁷³ American Declaration on the Rights of Indigenous Peoples, *supra* note 375, art. XXV(3).

⁴⁷⁴ *Awas Tingni*, *supra* note 388, ¶ 149; see also *Xákmok*, *supra* note 388, ¶ 86; *Yakye Axa*, *supra* note 388, ¶ 131; *Saramaka*, *supra* note 388, ¶¶ 90, 96; *Sawhoyamaxa*, *supra* note 388, ¶ 118.

⁴⁷⁵ *Awas Tingni*, *supra* note 388, ¶ 149.

⁴⁷⁶ *Saramaka*, *supra* note 388, ¶ 122.

⁴⁷⁷ *Id.*

⁴⁷⁸ *Id.*, ¶ 154; *Belize Maya*, *supra* note 348, ¶¶ 149-150 (citing with approval Afr. Comm’n on Human and Peoples’ Rights, *Social and Economic Rights Action Center and the Center for Economic and Social Rights v. Nigeria*, Communication No. 155/96 (Oct. 27, 2001)).

⁴⁷⁹ *Saramaka*, *supra* note 388, ¶ 154.

⁴⁸⁰ *Id.*

⁴⁸¹ *Id.*, ¶¶ 148, 153, 194.

⁴⁸² *Id.*, ¶ 117.

⁴⁸³ *Id.*

⁴⁸⁴ See *Dogan and Others v. Turkey*, App. Nos. 8803-8811/02, 8813/02 and 8815-8819/02, Eur. Ct. H.R., ¶ 138-39 (June 29, 2004) (*Dogan*); see also Convention for the Protection of Human Rights and Fundamental Freedoms, Nov. 4, 1950, 213 U.N.T.S. 221, Protocol 1, art. 1; *Oneryildiz v. Turkey*, App. No. 48939/99, Eur. Ct. H.R., ¶ 129 (June 18, 2002) (“applicant’s proprietary interest in his dwelling was of a sufficient nature and sufficiently recognised to constitute a substantive interest and hence a ‘possession’ within the meaning of the rule laid down in the first sentence of Article 1 of Protocol No. 1”).

⁴⁸⁵ See, e.g., *Dogan*, *supra* note 484, ¶ 138; *Oneryildiz*, *supra* note 484, ¶¶ 124, 129.

⁴⁸⁶ UNDRIP, *supra* note 432, art. 26.

⁴⁸⁷ *Id.*, art. 25.

⁴⁸⁸ *Id.*, arts. 29(1), 26(3).

⁴⁸⁹ *Awas Tingni*, *supra* note 388, ¶ 149; see also *Xákmok*, *supra* note 388, ¶ 86; *Yakye Axa*, *supra* note 388, ¶ 131; *Saramaka*, *supra* note 388, ¶¶ 90, 96; *Sawhoyamaxa*, *supra* note 388, ¶ 118.

⁴⁹⁰ *Saramaka*, *supra* note 388, ¶ 122.

⁴⁹¹ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 273 (citations omitted).

⁴⁹² *Id.*, ¶ 276 (“Indigenous peoples’ right to be consulted about decisions that may affect them is directly related to the right to cultural identity, insofar as culture may be affected by such decisions.”).

⁴⁹³ *Id.*, ¶¶ 302, 304.

⁴⁹⁴ *Id.*, ¶¶ 292, 315, citing *Special Rapporteur James Anaya, Promotion and Protection of All Human Rights, Civil, Political, Economic, Social and Cultural Rights Including the Right to Development: Report of the Special Rapporteur on the Situation of Human Rights and Fundamental Freedoms of Indigenous People*, A/HRC/12/34 (July 15, 2009), ¶¶ 48-9; see also Inter-Am. C.H.R., *Extractive Industries and indigenous peoples’ rights report*, *supra* note 390, ¶ 183.

⁴⁹⁵ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 293.

⁴⁹⁶ *Id.*, ¶ 305; Inter-Am. C.H.R., *Extractive Industries and indigenous peoples’ rights report*, *supra* note 390, ¶ 207.

⁴⁹⁷ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 308, citing *Saramaka*, *supra* note 388, ¶ 133; Inter-Am. C.H.R., *Extractive Industries and indigenous peoples’ rights report*, *supra* note 390, ¶ 198.

⁴⁹⁸ Inter-Am. C.H.R., *Extractive Industries and indigenous peoples’ rights report*, *supra* note 390, ¶ 183; *Saramaka*, *supra* note 388, ¶¶ 133-37.

⁴⁹⁹ *Saramaka*, *supra* note 388, ¶ 134.

⁵⁰⁰ UN Report of the Special Rapporteur on the Rights of Indigenous Peoples, James Anaya, *Extractive Industries*, U.N. Doc. A/HRC/24/41, July 1, 2013, ¶ 27.

⁵⁰¹ *Id.*, ¶ 27. Even if the impacts are not significant or direct enough to require indigenous consent, “[i]n all instances of proposed extractive projects that might affect indigenous peoples, consultations with them should take place and consent should at least be sought.” *Id.* (emphasis added).

⁵⁰² Section IV.B. 3.

⁵⁰³ Organization of American States, Rules of Procedure of the Inter-American Commission on Human Rights, art. 31(1) (Inter-Am. C.H.R. Rules).

⁵⁰⁴ *Id.*, art. 31(2)(a).

⁵⁰⁵ Inter-Am. C.H.R., Admissibility Report No. 48/15, Petition 79-06, *Yaqui People (Mexico)*, July 28, 2015, ¶ 51. *See also* Inter-Am. C.H.R., Admissibility Report No. 105/09, Petition 592-07, *Hul'Qumi'Num Treaty Group (Canada)*, October 30, 2009, ¶ 41 (*Hul'Qumi'Num Treaty Group*) (citing Inter-Am. C.H.R., Admissibility Report No. 16/04, Petition 129-02, *Tracy Lee Housel (United States)*, February 27, 2004, ¶ 36).

⁵⁰⁶ Inter-Am. Ct. H.R., *Velásquez Rodriguez Case*, Judgment of July 29, 1988, (Ser. C) No. 4, ¶ 64 (*Velásquez-Rodriguez v. Honduras*). *See also* *Hul'Qumi'Num Treaty Group*, *supra* note 505, ¶ 31 (“The jurisprudence of the inter-American system clearly indicates that only those remedies that are suitable and effective, if pertinent, in resolving the matter in question, must be exhausted.”); Inter-Am. C.H.R., Admissibility Report No 69/04, P504/03, *Community of San Mateo de Huanchor and its members (Peru)*, October 15, 2004, ¶ 56 (“In all domestic law systems, there are many remedies, but they are not all applicable to all circumstances.”); Inter-Am. Ct. H.R., *Gilson Nogueira Carvalho Case*, Judgement of October 3, 2000, (Ser. C) No. 12,058, ¶ 60 (“[T]he merely theoretical existence of legal remedies is not sufficient for this objection to be invoked: they have to be effective.”).

⁵⁰⁷ Inter-Am. C.H.R., *Indigenous and Tribal Peoples' Rights*, *supra* note 358, ¶ 44.

⁵⁰⁸ *Id.*

⁵⁰⁹ Inter-Am. C.H.R., Admissibility Report No. 76/07, Petition 198-07, *The Kaliña and Lokono Peoples (Suriname)*, October 15, 2007, ¶ 56, <http://cidh.org/annualrep/2007eng/Suriname198.07eng.htm>, holding that “the petitioner may be excepted from the requirement to exhaust all domestic remedies if it is clearly evident in the record that the proceedings brought in connection with the petition do not suggest reasonable prospects of success, in view of the prevailing case law of the State’s highest legal bodies.”

⁵¹⁰ *Id.*, ¶ 58, holding that “the State’s obligation to provide judicial recourse is not simply met by the mere existence of courts or formal procedures, or even by the possibility of resorting to the courts. Rather, the State has to adopt affirmative measures to guarantee that the recourses it provides through the justice system are really effective for determining the existence of a human rights violation and providing the corresponding compensation” (quotations omitted); and Inter-Am. C.H.R., Admissibility Report No. 87/12, Petition 140-08, *Maya Kaqchikel Communities of Los Hornos and El Pericón I and Their Members (Guatemala)*, November 8, 2012, ¶ 36, holding that the State remedy mechanism did not work to address the petitioners’ claim to “secure recognition and protection of the property rights” over ancestral land for the “use and enjoyment of their land and its natural resources, free of interference.”

⁵¹¹ Petition for certification pursuant to 22 U.S.C. § 1978 of actions undertaken by Canadian nationals diminishing the effectiveness of the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere and the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (June 27, 2016). Under the Pelly Amendment, the Secretary of the Interior must undertake an investigation when foreign nationals may be engaging in a “taking” that diminishes the effectiveness of any international program for endangered or threatened species. When the Secretary’s investigation finds that such taking is occurring, she must certify this finding to the President. 22 U.S.C. § 1978(a)(2)-(3)(B). However, even if the Secretary certifies the harm from the mines, the only redress under this process is for the President, at his or her discretion, to issue trade sanctions – an action that is politically unlikely and would not in and of itself guarantee further action

from the Canadian Government to stop the mines. Moreover, the Pelly Amendment process affords no opportunity for a hearing or judicial review of the Government's final decision. Thus, the only remedy available in the U.S. is likely insufficient to address the grave dangers the mines pose.

⁵¹² Petition for certification pursuant to 22 U.S.C. § 1978 of actions undertaken by Canadian nationals diminishing the effectiveness of the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere and the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (Sept. 26, 2017).

⁵¹³ Notes from Petitioners on file.

⁵¹⁴ Statement of Cooperation on Protection of Transboundary Waters Between the State of Alaska Departments of Environmental Conservation, Fish and Game and Natural Resources and The Province of British Columbia Ministries of Environment, and Energy and Mines (Oct. 6, 2016) (Statement of Cooperation), <http://ltgov.alaska.gov/wp-content/uploads/sites/6/2016/10/20161006-Statement-of-Cooperation-Final.pdf>.

⁵¹⁵ See Byron Mallott, Meeting Minutes, Transboundary Workshop and Dialogue June 1, 2018 10:30a – 3:30p Vocational Training and Resource Center Juneau, Alaska (undated), <https://ltgov.alaska.gov/wp-content/uploads/sites/6/2018/08/6.1.2018-Transboundary-Workshop-and-Dialogue-Minutes-6.1.2018.pdf>.

⁵¹⁶ *Id.* at 9. For example, the Statement of Cooperation and the Bilateral Working Group formed pursuant to it have “no legal effect; impose no legally binding obligations enforceable in any court of law or other tribunal of any sort, nor create any funding expectation,” and any decision or recommendation by the Working Group “shall not be legally binding on either party or their agencies.” *Id.*

⁵¹⁷ Inter-Am. Ct. H.R., *Exceptions to the Exhaustion of Domestic Remedies*, Advisory Opinion OC-11/90, August 10, 1990, ¶ 31.

⁵¹⁸ *Id.*, ¶ 33.

⁵¹⁹ Inter-Am. C.H.R., Admissibility Report No. 87/12, Petition 140-08, *Communities of the Sipakepense and Mam Mayan People of the Municipalities of Sipacapa and San Miguel Ixtahuacán (Guatemala)*, April 3, 2014, ¶¶ 36 and 14.

⁵²⁰ *Anaya Canada Report*, *supra* note 401, ¶ 64.

⁵²¹ *Hul’Qumi’Num Treaty Group*, *supra* note 505, ¶ 39 and n.11.

⁵²² *Id.*

⁵²³ *Id.*

⁵²⁴ See, e.g., West Coast Environmental Law, *Why It’s Time To Reform Environmental Assessment In British Columbia* at 9, 17-19 (Jan. 2018) (West Coast Environmental Law), <https://www.wcel.org/sites/default/files/publications/2018-01-bc-eareform-backgrounder-web-final.pdf>.

⁵²⁵ Inter-Am. C.H.R., *Indigenous and Tribal Peoples’ Rights*, *supra* note 358, ¶ 299, citing Constitutional Court of Colombia, Judgment on Tutela action T-652, of November 10, 1998 (“the participation [of the indigenous peoples] is not reduced merely to an intervention in the administrative procedure aimed at ensuring the right of defense for those who have been affected by the authorization of the environmental license ... but has a larger meaning given the lofty interests it seeks to protect, such as those that go to the definition of the destiny and security of the subsistence of said communities.”).

⁵²⁶ Any mining project that produces more than 3,000 tons of ore per day or a gold mine that produces 600 tons per day is subject to a decision under CEAA 2012 as a designated project. *See Canadian Environmental Assessment Act, 2012, Regulations Designating Physical Activities, SOR/2012-147* (July 6, 2012); *see also* BC Ministry of Environment, Fact Sheet Mining Operations (June 2016), https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/mining_operations_fs.pdf.

⁵²⁷ *See, e.g.*, David Boyd, *From Environmental Assessment to Sustainability Assessment: A Way Forward for Canada*, Submission to the Expert Panel Reviewing Canada's Federal Environmental Assessment Processes (Dec. 15, 2016) (Boyd, *From Environmental Assessment to Sustainability Assessment*); West Coast Environmental Law, *supra* note 524, at 9, 17-19; BC First Nations Energy and Mining Council, Environmental Assessment and First Nations in BC: Proposals for Reform at 2-3 (20 August 2009) (BC First Nations Energy and Mining Council), <http://fnemc.ca/?portfolio=ea-proposals-for-reform>.

⁵²⁸ West Coast Environmental Law, *supra* note 524, at 8; BC First Nations Energy and Mining Council, *supra* note 527, at 2-3.

⁵²⁹ West Coast Environmental Law, *supra* note 524, at 8; BC First Nations Energy and Mining Council, *supra* note 527, at 26-27.

⁵³⁰ West Coast Environmental Law, *supra* note 524, at 8.

⁵³¹ *Id.* (citing Environmental Assessment Office, Recommendations of the Executive Director at 8 and 22 (17 December 2009); Environmental Assessment Office, Environmental Assessment Certificate #14-02 (14 October 2014)).

⁵³² *See id.* (citing *Do Rav Right Coalition v. Hagen*, 2005 BCSC 991, para 34 (aff'd 2006 BCCA 571); *Peace Valley Landowner Association v. British Columbia (Environment)*, 2015 BCSC 1129, para 94 (aff'd 2016 BCCA 377)).

⁵³³ *Id.*

⁵³⁴ *Id.* at 4.

⁵³⁵ BC Auditor General, *Managing the Cumulative Effects of Natural Resource Development in BC* at 5 (May 2015).

⁵³⁶ West Coast Environmental Law, *supra* note 524, at 9, 17-19; BC First Nations Energy and Mining Council, *supra* note 527, at 2-3.

⁵³⁷ West Coast Environmental Law, *supra* note 524, at 9, 17-19.

⁵³⁸ Public Consultation Policy Regulation, BC Reg 373/2002, s 7, http://www.bclaws.ca/Recon/document/ID/freeside/12_373_2002.

⁵³⁹ *Id.*, s 4.

⁵⁴⁰ West Coast Environmental Law, *supra* note 524, at 18-19.

⁵⁴¹ BC First Nations Energy and Mining Council, *supra* note 527, at 24-25.

⁵⁴² *Id.*

⁵⁴³ “The BC First Nations Energy & Mining Council (FNEMC) is a provincial First Nations non-profit organization. FNEMC’s mandate is to support and facilitate First Nation efforts to manage and develop energy and mineral resources in ways that protect and sustain the environment forever while enhancing the social, cultural, economic and political well-being of First Nations in British Columbia. The mandate was established by the BC First Nations Leadership Council – the political executives of the BC Assembly of First Nations, the First Nations Summit and the Union of BC Indian Chiefs – and

the Chiefs of British Columbia.” BC First Nations Energy and Mining Council, *About Us*, <http://fnemc.ca/about-us/>.

⁵⁴⁴ BC First Nations Energy and Mining Council, Environmental Assessment and First Nations in BC: Proposals for Reform, *supra* note 527, at 24-25.

⁵⁴⁵ *Id.* at 2-3.

⁵⁴⁶ See, e.g., Boyd, *From Environmental Assessment to Sustainability Assessment*, *supra* note 527, at 2; Denis Kirchhof *et al.*, *The Canadian Environmental Assessment Act, 2012 and Associated Policy: Implications for Aboriginal Peoples*, THE INTERNATIONAL INDIGENOUS POLICY JOURNAL, 4(3), Art. 1 (2013) (Kirchhof *et al.*); Meinhard Doelle, *CEAA 2012: The End Of Federal EA As We Know It?*, 24 JOURNAL OF ENVIRONMENTAL LAW AND PRACTICE 1 (2012).

⁵⁴⁷ See, e.g., Boyd, *From Environmental Assessment to Sustainability Assessment*, *supra* note 527, at 2.

⁵⁴⁸ See, Kirchhof *et al.*, *supra* note 546, at 10. The Canadian government’s current proposed amendments to the CEAA has also been criticized as “applying a fresh coat of paint to the same old EA model. It exempts the vast majority of projects and activities from review, provides no certainty that Indigenous jurisdiction and decision-making rights will be upheld, and gives the government broad discretion to trade environmental health for short-term economic and political gains.” Anna Johnston, West Coast Lawyers, *Canada’s proposed new Impact Assessment Act: Good from afar but far from good?* (Feb. 21, 2018), <https://www.wcel.org/blog/canadas-proposed-new-impact-assessment-act-good afar-far-good>.

⁵⁴⁹ For example, the central piece of legislation is the Indian Act, the general statute under which indigenous peoples’ status is defined and lands are governed and managed. Canada has also developed legislation to address the historical grievances regarding treaty and aboriginal rights called “comprehensive land claim agreements,” which address treaty claims to land that have been historically denied. At the federal level, twenty-four claims from indigenous communities have concluded. At the provincial level, the British Columbia Treaty Process, an independent Commission, exists to facilitate treaty negotiations between First Nations and the governments of Canada, has thus far produced two final agreements between indigenous tribes and Provincial governments. Furthermore, indigenous peoples can go through the Special Claims Tribunal to attempt to settle land debt owed from historic treaties in which indigenous groups lost land entitled to them. See, generally, *Anaya Canada Report*, *supra* note 401, ¶¶ 6 and 7.

⁵⁵⁰ *Hul’Qumi’Num Treaty Group*, *supra* note 505, ¶ 1.

⁵⁵¹ *Id.*, ¶ 35.

⁵⁵² *Id.*

⁵⁵³ *Id.*, ¶ 37.

⁵⁵⁴ *Id.*, ¶ 38.

⁵⁵⁵ *Id.*, ¶ 37. The court also found the other remedies suggested by Canada to be ineffective because “they cannot be used to comprehensively and permanently protect all HTG ancestral lands from the actions of third parties because their purpose is not to recognize the HTG’s property rights to those lands or the obligation of the State to provide restitution.” *Id.*, ¶ 43.

⁵⁵⁶ *Hul’Qumi’Num Treaty Group*, *supra* note 505, ¶ 43.

⁵⁵⁷ *Anaya Canada Report*, *supra* note 401, ¶ 14.

⁵⁵⁸ *Id.*, ¶ 61.

⁵⁵⁹ *Id.*, ¶ 62.

⁵⁶⁰ *Id.*, ¶ 64.

⁵⁶¹ *Id.*

⁵⁶² *Id.*, ¶ 65.

⁵⁶³ *Id.*

⁵⁶⁴ *Charter of Rights and Freedoms*, Part 1 of the *Constitution Act*, 1982, being Schedule B to the *Canada Act 1982* (UK), 1982, c 11.*Id.*, ¶41 (Constitution Act of 1982).

⁵⁶⁵ *Id.*, § 1.

⁵⁶⁶ *Davis v. Canada (Attorney General)*, 004 NLSCTD 153 (2004), 240 Nfld. & P.E.I.R. 21 (NFTD), ¶ 92, *aff'd* [2008] N.J. No. 280 (C.A.); *see also Brown v. Canada (Attorney General)* [2010] O.J. No. 2253 (S.C.J.), ¶ 118 (citing *id.*).

⁵⁶⁷ *Davis v. Canada*, *supra* note 566, ¶ 2.

⁵⁶⁸ *Id.*, ¶ 94 (emphasis added); *see also Brown v. Canada (Attorney General)*, *supra* note 566, ¶ 118 (emphasis added) (citing *id.*).

⁵⁶⁹ *Ktunaxa Nation v. British Columbia* (Forests, Lands and Natural Resource Operations), 2017 SCC 54, <https://scc-csc.lexum.com/scc-csc/scc-csc/en/item/16816/index.do>.

⁵⁷⁰ *Id.*

⁵⁷¹ *Id.*

⁵⁷² Constitution Act of 1982, *supra* note 564, § 27.

⁵⁷³ *Hul-Qumi'Num Treaty Group*, *supra* note 505, ¶ 37.

⁵⁷⁴ Inter-Am. C.H.R. Rules, *supra* note 503, art. 32(1).

⁵⁷⁵ *See American Convention*, *supra* note 349, art. 63(1) (“If the Court finds that there has been a violation of a right or freedom protected by this Convention, the Court shall rule ... that the consequences of the measure or situation that constituted the breach of such right or freedom be remedied and that fair compensation be paid to the injured party.”); *see also Velásquez-Rodríguez v. Honduras*, *supra* note 506, ¶ 54 (ordering compensation for human rights violations: “the obligation to indemnify is not derived from internal law [of the violating nation], but from violation of the American Convention. It is the result of an international obligation.”).

⁵⁷⁶ *Xákmok*, *supra* note 388, ¶ 291.

⁵⁷⁷ *Id.*, ¶ 277.

⁵⁷⁸ *See id.*, ¶ 291.

⁵⁷⁹ Canadian Environmental Protection Act, *supra* note 371, pmb.

⁵⁸⁰ *Id.*, art. 2(1)(a.1) (“Administrative Duties”); *see also id.*, art. 2.(1)(l) (“endeavour to act with regard to the intent of intergovernmental agreements and arrangements entered into for the purpose of achieving the highest level of environmental quality throughout Canada”).

⁵⁸¹ UN Report of the Special Rapporteur on the Rights of Indigenous Peoples, James Anaya, *The Situation of Indigenous Peoples' Rights in Peru with Regard to the Extractive Industries*, A/HRC/27/52/Add.3, ¶ 10, July 3, 2014.

TABLE OF APPENDICES

Appendix No. Description

- 1 Report of David M. Chambers, Ph.D., P. Geop. (Nov. 14, 2018)
- 2 Assessment by Kendra Zamzow, Ph.D., Re: Reliability of Water Quality Predictions at the KSM Mine Relevant to Aquatic Life in the Unuk River (Mar. 21, 2018)
- 3 Report of Sarah O'Neal (Nov. 13, 2018)
- 4 Map of Transboundary Watersheds and Southeast Alaska Native Communities Threatened by B.C. Mines (Oct. 19, 2018)

APPENDIX 1

REPORT OF DAVID M. CHAMBERS, PH.D., P. GEOP.

REPORT OF DAVID M. CHAMBERS, PH.D., P. GEOP.

I. BACKGROUND

1. I am a professional geophysicist and the president of the Center for Science in Public Participation (CSP2). CSP2 is a non-profit corporation based in Bozeman, Montana, which provides technical assistance on mining and water-quality issues to public interest organizations and tribal governments throughout the United States.

2. I received a Mineral Engineering-Physics degree from the Colorado School of Mines in 1969. I received a Master's degree in Geophysics in 1976 and a Ph.D. in Environmental Planning in 1985, both from the University of California at Berkeley.

3. I am a Registered Professional Geophysicist (GP #972) in the State of California. I received my certification in 1991.

4. I have over 40 years of experience in the field of mineral exploration and development, including 15 years of technical and management experience relating to mining and mineral exploration. During this time, I have advised public interest organizations and tribal governments on the environmental effects of mining projects, both nationally and internationally.

5. I have provided technical assistance to various entities on proposed, operating, and abandoned mines in 17 states (including Alaska), four Canadian provinces (including British Columbia), Kyrgyzstan, and Northern Ireland. This assistance has included review of underground and open pit mine design, seismic stability for tailings dams, waste rock facilities design, water quality monitoring, water treatment facility design, reclamation planning, and financial assurance for mine closure.

6. Through my education, research, and work experience I have developed an expertise in assessing the environmental impacts of mining operations with a focus on metal mines and their impacts to surface and groundwater quality. I also have extensive experience in

analyzing the occurrence of tailings dam failures, and their impacts and cost; and, the costing of reclamation and closure sureties for hard-rock mines.

7. I have been asked by the Southeast Alaska Indigenous Transboundary Commission (SEITC) and Earthjustice to explain the hard-rock mining process, the kinds of environmental harms hard-rock mining can generate as a general matter, and the threats posed to the watersheds downstream of hard-rock mines in the British Columbia-Alaska transboundary watersheds in particular. I address each subject matter in what follows.

II. THE HARD-ROCK MINING PROCESS

8. In order to understand the impacts that hard-rock mines could have in the British-Columbia-Alaska transboundary watersheds, it is necessary to have a basic understanding of what hard-rock mining entails. The process of mining runs from discovery of an ore body, through extraction of minerals, and finally to returning the land to its natural state. This process consists of several distinct steps.

Prospecting and Exploration:

9. The first step is discovery of the ore body, which is carried out through prospecting or exploration to find and then define the extent, location, and value of the ore body.

10. Discovery culminates in an estimation of the size and grade of the deposit. This estimation supports an assessment of the theoretical economics of the ore deposit, on which a mining company will decide whether further investment is warranted, and identifies key risks and areas for further work.

11. When a mining company makes the decision whether to develop the mine, planning takes place to evaluate the economically recoverable portion of the deposit, the metallurgy and target mineral(s) recoverability, and marketability of the ore concentrates,

engineering concerns, milling and infrastructure costs, finance and equity requirements, and an analysis of the proposed mine from the initial excavation all the way through reclamation and closure. The proportion of a deposit that is economically recoverable is dependent on the enrichment factor of the ore.

Infrastructure construction:

12. The next step is construction of mine infrastructure. Once the analysis determines a given ore body is worth recovering, development begins to create access to the ore body. The mine buildings and processing plants are built, and any necessary equipment is obtained. The operation of the mine to recover the ore begins and continues as long as the company operating the mine finds it economical to do so. Once all the ore that the mine can produce profitably is recovered, reclamation begins to make the land used by the mine suitable for a future use.

Extraction:

13. The next step is mineral extraction. To gain access to the mineral deposit within an area it is often necessary to mine through and remove material (overburden and non-ore containing rock) that is not of immediate interest to the miner. The extraction process involves the movement of ore and waste. Often mining produces more waste than ore over the life of a mine, depending on the mining method and the nature of the ore body.

14. Waste removal and placement is a major cost to the mining operator, so a detailed characterization of the waste material forms an essential part of the geological exploration program for a mining operation.

15. Mining techniques can be divided into two common excavation types: surface mining and underground mining. Today, surface mining is much more common; 85 percent of minerals (excluding petroleum and natural gas) in the United States, including 98 percent of

metallic ores are produced via surface mining. Surface mining is done by removing (stripping) surface vegetation, dirt, and, if necessary, layers of rock in order to reach buried ore deposits. The most common technique utilized for metals mining is open-pit mining, which entails recovery of materials from an open pit in the ground. An alternative technique is underground mining, which consists of digging tunnels or shafts into the earth to reach buried ore deposits. Ore, for processing, and waste rock, for disposal, are brought to the surface through adits and shafts. Underground mining methods include shrinkage stope mining, which is mining upward, creating a sloping underground room; block caving, where a large underground area is blasted at the same time, producing a large zone of rubble that allows gravity to be used to collect the ore; and, room and pillar mining, which is removing ore from rooms while leaving pillars in place to support the roof of the room. Room and pillar mining often leads to retreat mining, in which supporting pillars are removed as miners retreat, allowing the room to cave in, thereby loosening more ore. Additional sub-surface mining methods include drift and fill mining, long-hole slope mining, sub level caving, and long wall mining.

Processing and tailings management:

16. The next step is mineral processing. Most metals are present in ores as oxides or sulfides. The metal needs to be reduced to its metallic form. Once ore is extracted, it must be processed by the mechanical means of crushing, grinding, and washing that enable the separation of valuable metals or minerals from the gangue (waste material). After lode ore is crushed, recovery of the valuable minerals is done by one, or a combination of several, mechanical and chemical techniques. Processing usually occurs onsite due to the economic inefficiencies involved in transporting unprocessed ore. Waste, which typically constitutes over 99 per cent of the material mined, will remain on the minesite.

17. Ore mills generate large amounts of waste, called tailings. For example, 99 tons of waste are generated per ton of copper, with even higher ratios in gold mining - because only 5.3 g of gold is extracted per ton of ore, a ton of gold produces 200,000 tons of tailings. (As time goes on and richer deposits are exhausted - and technology improves to permit - this number is going down to 0.5 g/ton and less.) These tailings can produce toxic discharges to water and air.

18. Tailings are usually produced as a slurry, and can be disposed of using different techniques, including dry-stacking and wet closure.

19. Tailings can be dry stacked, meaning that tailings slurry is dewatered, and the filtered tailings are deposited in compacted piles.

20. Another common technique is wet closure. Wet closure involves leaving the tailings saturated and submerging them under water in order to slow the oxidization process. The impounded tailings and water must be separated from the surrounding environment, often by means of a dam. These dams must effectively stand in perpetuity, since the oxidization process will generate acid-mine drainage (“AMD”) for millennia.

21. The waste is classified as either acid or non-acid generating, and the disposal of this material forms a major part of the mine planning process. Civil engineering design parameters are used in the design of the waste dumps, and special conditions apply to high-rainfall areas and to seismically active areas. Waste dump designs must meet all regulatory requirements of the country in whose jurisdiction the mine is located.

Reclamation:

22. The final step in mining is reclamation. Mine reclamation is the process of restoring land that has been mined to a natural or economically usable state.¹ Planning for mine

¹ Wikipedia, 25May17.

reclamation activities occurs prior to a mine being permitted or constructed. Mine reclamation attempts to create useful landscapes that might meet a variety of goals ranging from the restoration of productive ecosystems to the creation of industrial resources. The reclamation plan is typically accompanied by a financial surety that will pay for the planned reclamation if the mining company is unable to do the work itself. During reclamation buildings and other infrastructure that do not have a post-mining use are removed. Tailings facilities and waste rock piles require some long-term maintenance and monitoring, so some roads will remain, and money to fund these activities must be set aside.

III. ACID MINE DRAINAGE

23. A pervasive environmental problem associated with mining is acid mine drainage (“AMD”). AMD refers to pollution that is generated at mine sites when iron sulfide minerals are exposed to, and react with, oxygen and water, generating sulfuric acid. The sulfuric acid increases the rate at which metals from the rock such as iron, copper, aluminum, etc., dissolve. As a result, waters that have been exposed to oxidized sulfide rock (“contact waters”) are characterized by depressed pH values (acidity) and/or elevated concentrations of dissolved heavy metals. Such waters can be toxic to aquatic life, and can cause serious harm to the environment.

24. Although the oxidation process occurs naturally, by exposing oxidizing materials, breaking them up (thereby significantly increasing their surface area), mining can greatly accelerate the rate at which oxidation reactions take place. Mining increases the exposure sulfide-rich materials in the walls of open pits, mine tunnels, waste rock, and most dramatically in the surface area of granular tailings.²

² Other factors that influence the oxidation of sulfide minerals are temperature, acidity levels (pH), ferric/ferrous iron equilibrium, and microbiological activity, especially in the form of *Thiobacillus ferrooxidans*. Acid Drainage is

25. Acid drainage is not a problem at every mine, even in sulfide rich zones. In some circumstances the reaction may be inhibited by a lack of water or oxygen. In others the surrounding soils may have buffering qualities that help neutralize the acid. Metals and sulfate may still be mobilized even though acid conditions do not appear. This is because the acidity is neutralized before it can be detected, but after the metal ions have been mobilized.

26. Metals-carrying contact waters can get into the environment. Incident precipitation is impossible to keep out of all the waste. All tailings dams, water collection trenches, and interception well fields leak to some extent. Closed pits and underground workings that refill with water can contaminate groundwater. Waste rock piles, although they do not contain enough mineralization to justify processing, can still contain metals that leach into ground and surface waters. All are potential sources of contact waters that evade collection and contaminate waters off the mine site.

27. Unfortunately, AMD is a widespread problem. AMD occurs in many major mining regions, particularly those with temperate rainfall. In some cases the problems may be evident from the outset and steadily increase during the life of the mine. In others, AMD may only appear after a mine has closed and the company has left the area.

28. Where it does occur, AMD can have a serious impact on the productivity of ecosystems. The combination of acidity and dissolved contaminants is known to kill most forms of aquatic life, at worst rendering streams nearly sterile and making water unfit for human consumption.

of less concern where mines exploit oxidized ore bodies. Because these deposits are less numerous and seem to be exploited more readily than sulfide deposits, some argue that the problem will increase as industry exhausts the oxide sites.

29. AMD problems persist in the environment. Acid-generating rock has the potential for long-term, severe impacts on surface and ground water and aquatic life. Once the process of acid generation has started, it is extremely difficult to stop. Once started the process can endure for centuries, even millennia. For example, acid generation in the Rio Tinto mining district in Spain is believed to have been caused by Roman or Phoenician miners.

30. In order to prevent AMD pollution, mining companies can employ two strategies.

31. First, mining companies can design mine infrastructure to minimize the generation of contact waters, by keeping water away from acid-generating materials, and to contain the contact waters that are generated. Liners, consisting of both natural and synthetic material, can be placed on waste material to minimize infiltration. Tailings can be compacted to minimize seepage, and waste with high acid-generation potential can be placed on a liner. A double liner system with leak collection provides the most secure approach to seepage prevention and collection. Waste rock can be placed on a lined surface to minimize groundwater contamination. Seepage collection dams, interception trenches, seepage cutoff walls, and well-collection systems can be used to collect contaminated water before it leaves the mine site. None of these methods is adequate to prevent or isolate AMD entirely.

32. Second, once contact waters have been impounded, mining companies can mitigate the potential effects of these waters on the receiving environment—if or when they are released—by treating the waters. Treatment can occur actively or passively. Active treatment involves active manipulation of the treated water. A common method is to add lime to neutralize the acid and precipitate metals. The costs involved in operating an active treatment plant can be high. Capital costs for plant facilities are high, and operating cost significant due to reagent and labor costs. Passive treatment involves developing a self-operating system that can treat AMD

effluent without constant human intervention. An example would be passing the water through an artificial wetland where organic matter, bacteria, and algae work together to filter, adsorb, absorb, and precipitate out the heavy metal ions and reduce the acidity.

33. In addition, treatment plans often do not work according to plan. For example, a report by Kuipers-Maest found that adverse impacts to water quality are common at mine sites, and they are most often caused by failed mitigation.³ The mines that have begun operation (Red Chris, Brucejack), and the mines proposed (KSM, Galore Creek, Schaft Creek) are all large copper porphyry deposits that, because of their size and geochemical characteristics, are the type of deposit that has proved most problematic at containing contamination. The Kuipers-Maest report documents these problems at the Bagdad and Ray mines in Arizona; the water-related problems at these mines persist despite being located in the Arizona desert. Given the number of mines proposed for the region, and the history of mine problems in much drier locations, it is my opinion that water-related problems related to these transboundary mines are inevitable.

IV. TAILINGS STORAGE FAILURES

34. A second environmental problem associated with hard-rock mining is the potential for failure of tailings storage facilities. As discussed above, tailings are often impounded underwater behind large dams. If a dam were to fail, a release of the tailings behind the dam could lead to long-term environmental damage with huge cleanup costs. If the tailings behind the dam are saturated, then they will easily flow through the dam breach, and will move significantly further than if they were unsaturated. Tailings dams must effectively stand in

³ J. R. Kuipers *et al.*, *Comparison of Predicted and Actual Water Quality at Hardrock Mines* (2006).

perpetuity, since the tailings cannot be safely released to the environment, and the viability of guaranteeing the viability of any manmade structure in perpetuity is questionable at best.

35. Catastrophic tailings dam failures have occurred in the past. Dams have been used to impound tailings for about a century.⁴ During this period, there have been over two hundred tailings dam failures around the world. The proportion of failures that are serious (large enough to cause significant impacts or involved loss of life) or very serious (catastrophic dam failures that released more than 1 million cubic meters of tailings) is rising: of recorded serious and very serious failures between 1940 and 2010, 49 percent occurred since 1990.⁵ Based on these data, studies project 11 catastrophic failures during the 2010 to 2020 decade.⁶

36. Alaskans, like their British Columbia neighbors, were shaken by the catastrophic failure of the tailings dam at the Mount Polley copper-gold mine on August 4, 2014, the largest mine-waste spill in Canadian history. The dam collapse sent 24 million cubic meters of mining waste into a stream below the operation, virtually bulldozing the stream from 5 meters to 100 meters in width, and depositing most of the waste into Quesnel Lake, a large salmon-spawning glacial lake in the watershed below the tailings dam. The Mount Polley failure was an occurrence that professional consultants and government regulators considered impossible: it was a modern dam engineered and supervised by reputable engineering companies, operated by a respected mining company, and regulated by an experienced, developed-country regulatory agency. However, the Mount Polley dam failed because the dam was over steepened as it was being constructed, coupled with an undetected glacial lake in the dam foundation that led to a

⁴ David M. Chambers & Bretwood Higman, *Long Term Risks of Tailings Dam Failure* at 1 (2011).

⁵ Lindsay N. Bowker & David M. Chambers, *The Risk, Public Liability, & Economics of Tailings Storage Facility Failures* at 1 (2015).

⁶ *Id.* at 2.

catastrophic instability. The Mount Polley Expert Panel also found it could have failed by overtopping, which it almost did in May, 2014; and, that it could also have failed by internal erosion, for which some evidence was discovered during the post-accident investigations.

Clearly, multiple failure modes were in progress, and they differed mainly in how far they had progressed down their respective failure pathways.⁷

37. More recently, on November 5, 2015, the Fundão tailings dam failed in Minas Gerais, Brazil, releasing over 60 million cubic feet of iron ore tailings. The tailings destroyed the downstream village of Bento Rodrigues, killing 19 people, and emptying into the Doce River on its route to the Atlantic Ocean. The resulting liabilities are valued in the multiple billions of dollars.⁸ Although there is still a legal investigation in process at the time of this writing, it appears the dam was being operated in violation of the design operating guidelines, and that there was no qualified engineer with the responsibility of making these operating decisions.⁹

38. The frequency of tailings dam failures suggests that there is a problem with how these structures are regulated. Past research has demonstrated that tailings dams fail at a significantly higher rate than dams built for water-supply reservoirs.¹⁰ My co-author and I have concluded that this significant difference is attributable to the economic incentives to make present day decisions about risk less, rather than more, conservative about the magnitude of these risks. As the failures at Mount Polley and Fundao demonstrate, mine production considerations

⁷ Independent Expert Engineering Investigation and Review Panel, *Report on Mount Polley Tailings Storage Facility Breach*, Province of British Columbia, January 30, 2015, at 126.

⁸ See, e.g., Anthony Boadle & Stephen Eisenhammer, *Vale/BHP's Samarco to pay \$5.1 billion in damages for dam disaster*, REUTERS (Mar. 3, 2016) <http://www.reuters.com/article/us-brazil-damburst-deal-idUSKCN0W42WP>.

⁹ Fundão Tailings Dam Review Panel, *Report on the Immediate Causes of the Failure of the Fundão Dam*, August 25, 2016, at 8-11.

¹⁰ Michael P. Davies, *Tailings Impoundment Failures: Are Geotechnical Engineers Listening?* Geotechnical News, September 2002, at 32.

overrode dam design safety considerations, and led to the failure of these dams, notwithstanding the companies' assurances that they could not fail. From an engineering standpoint, the higher incidence of tailings dam failures relative to those of water-supply reservoir dams is probably shaped by two factors: (1) the use of construction types for tailings dams that are more susceptible to failure; and, (2) that tailings dams are most often constructed in sequential 'lifts' over several years that make quality control more challenging relative to water supply dams that are constructed all at once.

39. The different types of dam construction that can be used for tailings facilities contribute significantly to the increased risk for tailings storage facility dams. Unlike water, the tailings themselves can be, and are, used for partial, or sometimes full, support of the dam. In downstream-type construction the dam takes the triangular shape of a conventional water supply reservoir dam. This is the most stable form of dam construction, even when it is constructed in incremental lifts. In upstream-type construction the dam is constructed in increments on the tailings as they dry, post-deposition. This technique relies on the stability of the tailings, some of which will remain saturated. Saturated material can liquefy under pressure or earthquake loading, so this is the least stable dam construction type, and not surprisingly the type associated with most tailings dam failures.

40. Unlike water-reservoir dams, which are usually built in one operation and can then be given a rigorous final inspection, tailings storage facilities are built continuously, possibly over the many years of the mine's life. This means quality control is much more difficult. During this time the ownership or management may have changed, and there will have been considerable turnover in staff. These discontinuities can contribute to errors of omission in the quality control process. Even if original design parameters were sound, they may be lost

(e.g. during unanticipated delays), they may not be followed with sufficient care (e.g. new management may place primary emphasis on meeting construction targets), or operations may change to render them obsolete (e.g. by generating tailings in excess of the originally planned height). Staff will turnover, and the level of on-site expertise usually falls once the project completes construction and commences normal operations. Meanwhile, the properties of the tailings may also have changed as the mine enters new ore zones or as processing technology is adjusted.

41. A qualified engineer is needed to ensure that the company carries out any necessary adjustment in design as conditions change. Without the proper academic background and on-the-job experience, it is not reasonable to expect an untrained person to see many of the problems that may occur at the facility, and would be unprepared to make judgements, and accept responsibility, for design-related changes to a tailings dam. At the present time, a qualified engineer typically works for a consulting company, will visit the mine site only occasionally, and must rely largely on recordkeeping to determine if the dam is being constructed and operated as designed.

42. Lenders, insurers, governments, and local communities rarely provide effective oversight. Although lenders and insurers have a clear interest in better practice in this area since the debtor/policy holder bears the costs of clean-up, monitoring costs can reduce their incentives to conduct oversight, and they instead essentially price failures into the costs of capital or premiums. Governments pay most attention to the early stages—ensuring perhaps that there are suitable regulations about initial design but making few stipulations about ongoing stewardship. Governments also often lack sufficient skilled staff to monitor conditions or step in when problems arise.

43. Finally, both companies and local administrations frequently fail to ensure effective risk assessment, emergency planning, and financial surety for compensation of catastrophic accidents like Mount Polley and Fundão. Industry organizations are providing guidance for improvements in some, but not all, of these areas.¹¹

44. Tailings storage facilities require careful attention during design, operation, and post mine closure. This requires an effective mix of professional diligence, and government oversight. Ultimately humans are the weak link in maintaining the safety of tailings dams. Procedures must be set in place to counter this effect – both recognizing this human weakness, and essentially answering the question of what we do if something goes wrong. Right now both industry and regulators assume that everything will work as planned.

V. THE TRANSBOUNDARY MINES

45. In the past decade British Columbia has experienced a mining boom. The Ministry of Energy and Mines recently boasted that it had permitted seven new mines and nine major mine expansions since 2011.¹² Among the proposed mines are projects in the transboundary watersheds of Taku, Stikine, and Unuk rivers. Here at least six mines are of significant concern to Alaskans, due to the potential for downstream water pollution and the destruction of watersheds these projects present over the long-term.

46. In the Taku River watershed Chieftain Metals Corporation proposed the Tulsequah Chief Mine, a gold, silver, copper, lead, and zinc project on the east side of the Tulsequah Valley, near the confluence of the Tulsequah and Taku rivers, ten miles (16

¹¹ For example, see *A Guide to the Management of Tailings Facilities*, Mining Association of Canada.

¹² B.C. Gov News, *Government actions renew B.C. as a leader in mining* (Feb. 28, 2017)
<https://news.gov.bc.ca/13979>.

kilometers) upstream of the Canada–United States border, and 40 miles (64 kilometers) northeast of Juneau, Alaska.¹³ The mine was expected to have an 11-year operating life, and to produce 4.4 million metric tons of total ore,¹⁴ while generating 2 million metric tons of tailings.¹⁵ Plans for the Tulsequah Chief Mine are in flux, as Chieftain Metals Corporation has gone into receivership.¹⁶

47. In the Stikine River watershed, three projects are in various stages of permitting.

48. Imperial Metals Corporation’s Red Chris Porphyry Copper-Gold Mine Project (“Red Chris Mine”) was the first project British Columbia issued a permit for following the Mount Polley disaster. Imperial Metals also owns the Mount Polley Mine. Over 25 years, the project is expected to extract 30,000 metric tons of ore per day,¹⁷ generating 338 million metric tons of waste rock,¹⁸ and 300 million metric tons of mine tailings.¹⁹

49. Copper Fox Metals Incorporated and Teck Resources Limited’s Schaft Creek Mine project is a planned open pit copper, gold, molybdenum, and silver mine project. Over the course of the mine’s 15-23 year operating life, the project is expected to extract around 100,000

¹³ SRK Consulting, Big Bull Project, Tulsequah Chief Property, Technical Report Northern British Columbia at 6 (2010) (Big Bull 2010 Technical Report); Tulsequah Chief 2014 Technical Report at 5-1; *see also* Fig. 2 (Map of the Tulsequah Chief Mine).

¹⁴ Tulsequah Chief 2014 Technical Report at 1-20.

¹⁵ *Id.* at 18-38, Tbl. 18.10.

¹⁶ Derrick Penner, *Tulsequah Chief owner pushed into receivership; environmental issues remain* (Sep. 8, 2016) <https://vancouversun.com/business/local-business/tulsequah-chief-owner-pushed-into-receivership-environmental-issues-remain>.

¹⁷ Environmental Assessment Office, Red Chris Porphyry Copper-Gold Project Assessment Report at 5 (2005) (Red Chris EA Report).

¹⁸ Red Chris EA Report at 81.

¹⁹ Klohn Crippen Berger Limited, *Tahltan Central Council: Red Chris Mine Site Review of Tailings Impoundment Design* at 4 (Oct. 2014), <http://tahltan.org/wp-content/uploads/2015/08/KCB-Red-Chris-Third-Party-Review.pdf>.

metric tons of ore per day,²⁰ generating over a billion metric tons of waste rock,²¹ and 800 million metric tons of tailings.²²

50. NovaGold Resources Incorporated and Teck Cominco Limited's Galore Creek Mine project copper-gold-silver mining project has received its environmental assessment and federal approval, and has received its initial construction permits from British Columbia. Over twenty years the project is expected to extract 346.6 million metric tons of ore,²³ generating over a billion metric tons of waste rock²⁴ and 475 million metric tons of tailings.²⁵

51. In the Unuk River watershed two projects are in various stages of permitting.

52. Seabridge Gold Incorporated's Kerr-Sulphurets-Mitchell ("KSM") Mine is a gold, silver, copper, and molybdenum mine project, which would probably be the largest mine in British Columbia. Over the course of its anticipated 52-year operating life, the KSM Mine would extract about 130,000 metric tons of ore per day²⁶ from three open pits and two underground block-cave mines,²⁷ producing over two billion metric tons of ore,²⁸ generating over three billion metric tons of waste rock,²⁹ and 2.3 billion metric tons of tailings.³⁰

²⁰ P. W. Scannell, Stikine River Mining Activity Risk Assessment, Alaska Department of Fish and Game, Technical Report No. 10-06 at 75 (2012) (Scannell).

²¹ *Id.* at 76.

²² *Id.* at 75.

²³ MEC Americas Limited, Galore Creek Project, British Columbia, NI 43-101 Technical Report on Pre-Feasibility Study at 14-13, Tbl. 14-4 (July 2011).

²⁴ Scannell at 28.

²⁵ British Columbia Environmental Assessment Office *et al.*, Galore Creek Copper-Gold-Silver Project: Comprehensive Study Report at 10 (Jan. 19, 2007).

²⁶ Seabridge Gold, Application for an Environmental Assessment Certificate / Environmental Impact Statement: KSM Project at 4-5 (July 2013) (KSM EA Application).

²⁷ *Id.* at 4-21.

²⁸ *Id.* at 4-5.

²⁹ *Id.*

³⁰ *Id.*

53. Prentium Resources Incorporated's Brucejack Mine project is an underground gold and silver mine currently under construction. Over the mine's 22-year operating life,³¹ it would extract around 2,700 metric tons of ore per day for a total of almost 19 million metric tons of ore,³² generating 4.87 million metric tons of potentially acid-generating waste rock,³³ and 15.8 million tons of tailings.³⁴

54. As discussed below, these projects will each pose risks to the surrounding and downstream environment.

55. All six projects can be expected to generate (or in the case of the Tulsequah Chief Mine, are already generating) AMD. All six projects involve the extraction of sulfide deposits and have the potential to generate AMD.

56. The KSM Mine exemplifies some potential impacts from transboundary mines. The project will generate three billion tons of waste rock,³⁵ over 71 per cent of which will be potentially acid generating.³⁶ Waste rock will be exposed to the elements in rock dumps.³⁷ Water that has contacted disturbed areas or materials will be diverted to a 63-hectare water

³¹ Canadian Environmental Assessment Agency, Brucejack Gold Mine Project, Environmental Assessment Report at 7, 11 (July 2015) (Brucejack EA Report); Brucejack EA Application at 1-30.

³² Brucejack EA Application at 1-40, Tbl. 1.9-5.

³³ *Id.* at 5-115 ("[I]t is estimated that about 0.67 million tonnes of PAG development rock will be produced from the underground mine during the construction stage 4.2 Mt of waste rock, assumed to be PAG, will be produced by the underground mining throughout the operating period").

³⁴ *Id.* at 5-118 ("The Project is expected to create about 15.8 Mt of flotation tailings over the life of the mine.").

³⁵ *Id.* at 4-5.

³⁶ *Id.* at 4-22 ("[T]he majority of the KSM Project rock is potentially acid-generating (PAG), particularly in the vicinity of the ore deposits. Substantial volumes of non-ore (waste) PAG rock must be mined in order to access the ore.").

³⁷ Seabridge Gold Inc., KSM Mine Project Environmental Effects Summary at 1 (July 2013) ("Mined waste rock will be stored in rock storage facilities (RFSs) in the Mitchell and McTagg creek valleys and placed as backfill in the mined-out Sulphurets Pit.").

storage facility.³⁸ The water storage facility will be located in a dammed section of Mitchell Creek,³⁹ from which it will be pumped to the water treatment plant.⁴⁰

57. The mine workings, both open pit and underground, will likely be sources of acid rock drainage. To mitigate pollution, once at the water treatment plant will treat wastewater with a high-density sludge lime water process before it is released to the environment.⁴¹

58. Treatment will need to continue after closure of the mine. The post-closure treatment costs are estimated to be \$20,383,500 per year for basic treatment, and \$6,656,620 for the selenium treatment plant. These costs do not include replacement costs that would be expected to occur over the life of the water treatment plant, including replacement of moving parts (e.g. every 10 years), stationary parts (e.g. every 20 years) and plant itself (e.g. every 50 years). Treatment will continue after closure of the mine for a period “until discharge quality meets targets.”⁴² The company and regulatory authorities operate under the assumption that these facilities will operate as planned for the duration of this period. This period is expected to last around 250 years.⁴³ Treated water will be released into Sulphurets Creek, which flows into the Unuk River.

59. Seabridge Gold Inc. (Seabridge) has prepared surface water quality predictions in the environmental impact statement (EIS) associated with the mine. According to the EIS, current drainage from natural acid-generating rock in the glacial valley in which the mine is

³⁸ *Id.* at 4-137. The storage facility will also receive effluent from a selenium treatment plant that will treat the selenium contaminated water that has been exposed to the waste rock from the Kerr Pit. *Id.* at 4-158.

³⁹ *Id.* at 4-137.

⁴⁰ *Id.* at 4-149.

⁴¹ *Id.*

⁴² Canadian Environmental Assessment Agency, KSM (Kerr-Sulphurets-Mitchell) Project: Comprehensive Study Report at 8 (July 2014), http://ksmproject.com/wp-content/uploads/2014/07/34-081-CEAA_KSM_EN_R4_X4.pdf.

⁴³ *Id.*

situated already contributes metals to the Unuk River system. The mine project is intended to capture these naturally metals-loaded waters, combine them with mine wastewater, and treat this combined feed water, before releasing effluent to the watershed.⁴⁴ According to Seabridge's water quality predictions, by treating captured naturally metals-loaded waters, the treatment plant would reduce concentrations of several metals. With the exception of selenium pollution (which Seabridge concedes would increase), Seabridge is predicting water quality in the Unuk River would improve.⁴⁵

60. My colleague Dr. Kendra Zamzow has examined the Seabridge predictions and concludes that Seabridge's predictions are misleading and potentially underestimate the effects that the mine will have on the watershed.⁴⁶ This is for several reasons.

61. First, Seabridge's predictions generalize from predicted changes in *total* levels of metals, but the absence of corresponding predictions for the *dissolved* forms of these metals is a critical weakness: Dissolved metals are a subset of total metals. The dissolved form of a metal is more bioavailable for fish, therefore, to evaluate potential impacts to fish it is more important to consider the dissolved concentration of a metal than its total level. As Dr. Zamzow points out in her analysis, Seabridge has not justified the position that treatment of mine effluent will reduce dissolved concentrations to the same degree that it reduces total concentrations. A metals total concentration may fall while the more bioavailable dissolved form declines less sharply, remains unchanged, or even increases.⁴⁷ Examining Seabridge's predictions, Dr. Zamzow observed that they included differences between rates of change in a metal's total and dissolved forms for

⁴⁴ See Kendra Zamzow, *Reliability of water quality predictions at the KSM mine relevant to aquatic life in the Unuk River* at 1 (Mar. 21, 2018) [hereinafter Zamzow Opinion].

⁴⁵ *Id.*

⁴⁶ See *id.* at 1-2.

⁴⁷ *Id.* at 3.

aluminum and iron, the only two metals for which the Company predicted both total and dissolved concentrations. With respect to these metals, not only did levels of the total and dissolved forms of the metals change at different rates, but for the 85th percentile concentration (what the State of Alaska looks at when evaluating water quality discharge permits) dissolved concentrations were predicted to increase in the Unuk River while total metals concentrations decreased relative to the baseline.⁴⁸ As a result, Seabridge may be overstating the efficacy of its treatment plan, and understating the risks that its project could pose to aquatic life downstream of the mine.⁴⁹

62. Second, Seabridge's predictions present what is likely an overly optimistic picture of the watershed once the mine is operating. Dr. Zamzow considered Seabridge's prediction using a mass balance comparison of baseline and predicted scenarios.⁵⁰ "Mass balance" refers to the amount of a metal present at a location in the water column at a given time, calculated by multiplying the concentration at a given location by the flow rate. Looking at mass balances allows tracking of metals entering and exiting the water column. Where mass balance increases, there is a source of metals; where it decreases, metals are precipitating out of the water column into sediment. The expectation was to observe similar patterns of precipitation of metals out of the water column in the baseline and predicted scenarios, with the exception of differences accounted for by the mine's diversion of naturally metals-loaded waters and the release of effluent at the wastewater plant.⁵¹ Dr. Zamzow's analysis indicated, however, that for several metals Seabridge's predicted mass balances were notably lower than what one would expect given the baseline's levels of metals precipitation. With respect to a number of metals potentially

⁴⁸ *Id.* at 3.

⁴⁹ *Id.* at 4.

⁵⁰ *Id.* at 4-7.

⁵¹ *Id.* at 4.

harmful to aquatic life, like selenium, cadmium, and copper, Seabridge assumed that rates of precipitation of metals out of solution would be higher in their predictions than were observed in the same segments of river in the baseline.⁵² The departures from observed precipitation in the baseline sample are unexplained.⁵³ Therefore, these predictions lead Dr. Zamzow further to question the reliability of Seabridge's predictions, which may underestimate the impacts of these metals from the mine.⁵⁴

63. Third, there are further reasons to expect that metals pollution is understated in Seabridge's model. The pilot plant used to demonstrate the capacity of its high-density sludge (HDS) process to remove metals from feed water used simulated feed waters that likely misrepresented waters from the naturally metals-loaded stream.⁵⁵ Pilot plant testing with a more accurate representation of feed water would have provided better information on how well the treatment facility could remove metals from effluent, and how much sludge would be produced in the process..⁵⁶ Seabridge also assumed that seepage from the Project would occur at a rate of one liter per second, with no seepage from underground chambers and tunnels.⁵⁷ Dr. Zamzow concluded that, without more information, one cannot know if this assumption is reliable. If Seabridge's one-liter-per-second assumption is overly optimistic, it will affect both feed water to the wastewater treatment plant, which could affect plant efficacy and cost, and potential sludge volume.⁵⁸

64. Perhaps most importantly, Seabridge's predictions are premised on the assumption that the treatment plant and mine infrastructure will work flawlessly for decades, a

⁵² *Id.* at 5-6.

⁵³ *Id.* at 7.

⁵⁴ *Id.* at 6-7.

⁵⁵ *Id.* at 7-8.

⁵⁶ *Id.*

⁵⁷ *Id.* at 8.

⁵⁸ *Id.*

highly questionable assumption. Large industrial operations do not operate flawlessly. Dr. Zamzow's report discusses several modern mines that offer examples of serious problems: In addition to the Mount Polley Mine, the Rock Creek Mine in Nome, Alaska offered predictions for water balance (the source and amount of water to be handled) that turned out to be inaccurate, which became a critical issue when the mine was forced to shut down two months into operation; the Buckhorn underground mine in Washington state, operators were unable to control contaminated groundwater, which is reaching surface waters. As Dr. Zamzow concluded, "the assumption of seamless perfection in the operation of relevant mine infrastructure is an unsound and dangerous assumption."⁵⁹

65. In sum, Seabridge's predictions are likely overly optimistic. Based on my experience with other mines, especially after mine closure, the actual ranges of downstream metals concentrations are likely to exceed baseline levels, including in the Unuk River, and the increase could be substantial. This opinion is based on the probability that containment and treatment systems will not operate seamlessly and consistently to reduce effluent concentrations to maintain baseline water quality, especially for the treatment systems that have been proposed, like for selenium, but have not demonstrated their effectiveness at a commercial scale.

66. The KSM Mine construction permit demonstrates that the British Columbia government is willing to authorize a mine project that will, as a matter of course, use downstream salmon waters—including waters in the United States—as mixing zones to dilute toxic mine wastes (presently for selenium). The failure of the State of Alaska to object to the B.C. proposal to use these waters as mixing zones for their toxic wastes indicates there is no

⁵⁹ *Id.* at 9-10.

reason to believe that Alaska will object to other B.C. permits, even if they risk contaminating waters in the United States.

67. All five other mines feature largely similar infrastructure and largely similar pollution-mitigation strategies—namely tailings and waste rock impoundments, with neutralizing water-treatment facilities for released contact waters. It is, therefore, possible that concentrations of metals will reach similar levels downstream of other mines.

68. The Tulsequah Chief Mine has been discharging untreated acid mine drainage directly into the Tulsequah River since its closure in 1957, when the mine was put into temporary closure by the then owner Cominco, Ltd. The B.C. plan for mitigating this discharge had been to operate to closure – that is, to approve an operating mine that would clean up, or treat, the acidic discharge before its closure. However, Chieftain Metals Corporation, the latest owner, is the second owner of the Tulsequah Chief mine to go into receivership.⁶⁰ Chieftain had been issued a water discharge permit by B.C. Ministry of Environment in April, 2012, which required water treatment and contained discharge limits.⁶¹ Three months later Chieftain wrote the B.C. Ministry of Environment to inform them that it was shutting down the water treatment plant, and would knowingly be in violation of its permit.⁶² Chieftain was allowed to continue operations at the site without sanctions or penalty until the time of their bankruptcy in 2016.

69. At the Red Chris Mine, mining operations are expected to generate 338 million metric tons of waste rock, of which “a significant proportion . . . is expected to become acid-

⁶⁰ Derrick Penner, *Tulsequah Chief owner pushed into receivership; environmental issues remain* (Sep. 8, 2016) <https://vancouversun.com/business/local-business/tulsequah-chief-owner-pushed-into-receivership-environmental-issues-remain>.

⁶¹ B.C. Ministry of Environment, Permit 105719, April 3, 2012.

⁶² Keith Boyle, Chief Operating Officer, Chieftain Metals Inc., *Letter to Environmental Enforcement Division, Environment Canada*, copy to B.C. Ministry of Environment, June 6, 2010.

generating,⁶³ releasing increased concentrations of metal contaminants.”⁶⁴ The mine drainage from the acid-generating waste dump will flow into the open mine pit, where it will be treated⁶⁵ before being released into the tailings impoundment. The British Columbia Environmental Assessment Office predicts that seepage water with elevated concentrations of metals pollutants could potentially escape the impoundment and “enter the receiving environment.”⁶⁶ “Treatment will likely be required in perpetuity.”⁶⁷

70. At Schaft Creek, the mine proponent has not provided sufficient information to determine how and if it plans to treat wastewater to mitigate the effects of acid mine drainage and metals contamination.⁶⁸ Prior to Teck Resource’s withdrawal of its EA application materials, the company’s plan was expected to generate over 100 million metric tons of acid-generating waste rock,⁶⁹ and so treatment of contact waters will be an issue.

71. At the Galore Creek project, the mine site will host more than a billion metric tons of waste rock will be generated over the operating life of the project.⁷⁰ Waste rock is expected to leach aluminum, antimony, boron, copper, fluoride, iron, lead, manganese, molybdenum, selenium, sulphate, and zinc into impoundment water.⁷¹ “Effluent from the mine site will be

⁶³ Imperial Metals Corporation, 2012 Technical Report on the Red Chris Copper-Gold Project, February 14, 2012, at 20-236.

⁶⁴ *Id.*

⁶⁵ Red Chris EA Application at 4-347.

⁶⁶ Red Chris EA Report at 24.

⁶⁷ *Id.* at 23.

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ Scannell at 28.

⁷¹ Galore Creek Comprehensive Study Report at 76 (“Other variables indicated elevated concentrations of several elements known to be associated with specific minerals in the deposit. These included copper (chalcopyrite), zinc (sphalerite), lead (galena) and fluorine (fluorite). Initial results from kinetic tests demonstrated that most elements leach at low rates. However, copper, cadmium, fluoride, manganese, selenium, sulphate and zinc were leached at concentrations greater than typical water quality criteria. The water quality model determined that other variables,

discharged from the tailings and waste rock impoundment into Galore Creek from mid-May to mid-October.”⁷² The Galore Creek processing site will also face an AMD issue. When ore concentrate is dewatered, waste water will be treated with lime and filtered.⁷³ In order to meet the receiving water quality criterion of 2 µg/L of copper, there will be further dilution of the waste water,⁷⁴ Treated effluent from the dewatering site will be discharged into the Iskut River.⁷⁵

72. The Brucejack Mine is expected to generate 4.87 million metric tons of potentially acid-generating waste rock,⁷⁶ as well as 15.8 million tons of tailings.⁷⁷ “77 to 85% of waste rock generated at the mine site is likely [potentially acid-generating] material. There is also enrichment of Ag [silver], As [arsenic], Cd [cadmium], Mo [molybdenum], Pb [lead], Sb [antimony], Se [selenium], and Zn [zinc] in waste rock and As, Sb, Ag and Cd may be a concern for metal leaching when waste rock is exposed to water.”⁷⁸ Waste rock and tailings will be piped to the bottom of Brucejack Lake, the tailings having been thickened to increase their solid content and mixed with a flocculant.⁷⁹ The project will have a water treatment plant,⁸⁰ though

including calcium, barium, aluminum, iron, boron, molybdenum, lead and antimony, would have significant loadings from waste rock to the tailings facility.”).

⁷² Galore Creek EA Application at 7-231.

⁷³ Scannell at 29.

⁷⁴ *Id.*

⁷⁵ Galore Creek Comprehensive Study Report at 14 (“After treatment, the clean water will be pumped . . . to the Iskut River where it will be discharged through a pipeline and diffuser system.”).

⁷⁶ *Id.* at 5-115 (“[I]t is estimated that about 0.67 million tonnes of PAG development rock will be produced from the underground mine during the construction stage . . . 4.2 Mt of waste rock, assumed to be PAG, will be produced by the underground mining throughout the operating period”).

⁷⁷ *Id.* at 5-118 (“The Project is expected to create about 15.8 Mt of flotation tailings over the life of the mine.”).

⁷⁸ Brucejack EA Application at 13-73 to 13-74.

⁷⁹ Brucejack EA Report at 28.

⁸⁰ *Id.* at 7.

doubts have been raised as to its effectiveness.⁸¹ The project's environmental assessment report concedes that the project "may . . . result in exceedance of some B.C. Water Quality Guidelines and/or Canadian Environmental Quality Guidelines thresholds in Brucejack Creek."⁸²

73. Like the KSM Mine, the five other mines will extract ore from potentially acid-generating materials; they will generate large quantities of waste rock and millions (in some cases hundreds of millions) of tons of tailings. The five other mines propose to treat water using means similar to the KSM Mine's: neutralization treatment, and dilution in downstream waters. These other mines will most likely be permitted by the British Columbia government largely as proposed, which not only generally has a record of inadequate environmental protection from mining,⁸³ but, in particular, has already permitted the KSM Mine. The five B.C. mines other than KSM Mine have not produced expected values for heavy metals concentrations at downstream salmon habitat sites. However, given the similarities in materials, infrastructure, and methods employed at the B.C. mines, it is possible that concentrations of dissolved metals downstream of these other mines could exceed levels reached at KSM. If such concentrations are exceeded in waters where salmon migrate or inhabit downstream of these mines, fish and

⁸¹ See *id.* at 28 ("Some uncertainty remains with respect to the effectiveness of the water treatment plant in mitigating water quality impacts in Brucejack Creek."); *id.* at 30 ("Uncertainty remains as to whether the proponent's water treatment plant will function as predicted because concentration estimates presented by the proponent regarding the effectiveness of the water treatment plant were based on professional judgment.").

⁸² *Id.* at 27.

⁸³ See Auditor General of British Columbia, AN AUDIT OF COMPLIANCE AND ENFORCEMENT OF THE MINING SECTOR 6-7 (May 2016), <http://www.bcauditor.com/sites/default/files/publications/reports/OAGBC%20Mining%20Report%20FINAL.pdf> (last visited May 11, 2016) ("[C]ompliance and enforcement activities of the mining sector are inadequate to protect the province from significant environmental risks. . . . Both ministries lack sufficient resources and tools to manage environmental risks from mining activities. . . . Neither ministry uses a permitting approach that reduces the likelihood taxpayers will have to pay costs associated with the environmental impacts of mining activities (known as the polluter-pays principle). . . . Both [ministries'] enforcement responses have significant deficiencies [T]he two ministries are not informing the public and legislators about the long-term risks from mining, the effectiveness of the agencies' regulatory oversight, and the overall performance of the companies being regulated.").

other aquatic organisms will be exposed to similar threats of AMD and metals-leaching pollution.

74. Another area of major concern is the potential of impacts from a catastrophic tailings impoundment failure. All of the B.C. mines propose wet closures, against the recommendation of the Mount Polley Expert Panel. Five of the six (all except for the Brucejack Mine, which uses a naturally occurring glacial lake as its tailings impoundment) propose or use dams to impound tailings. The dams associated with these projects use the same basic design as the dam at the Mount Polley Mine, but are much larger.

75. The Brucejack Mine is the only project that plans not to use a dam to impound its tailings. Approximately 1.6 million metric tons of the waste rock and 7 million metric tons of tailings will be used to backfill the underground mine stopes at closure.⁸⁴ The stopes will then be flooded to prevent oxidation of the rock.⁸⁵ The remainder of the waste rock and tailings will be piped to the bottom of Brucejack Lake.⁸⁶

76. In the Taku River watershed, the Tulsequah Chief Mine, as proposed by Chieftain Metals, included plans for a wet dammed tailings impoundment. The project is expected to produce over 2 million metric tons of tailings,⁸⁷ most of which, around 1.76 million metric tons,⁸⁸ would end up in a 45-hectare impoundment on the banks of Shazah Creek, 2.5 miles (4

⁸⁴ Brucejack EA Application at 5-115 (“Over time, as appropriate voids become available underground, much of this rock will be used as backfill. About 37%, or 1.58 Mt, of waste rock generated from mining activities will be disposed of in the lake.”); *id.* at 5-118 (“Approximately 7.1 Mt of the flotation tailings will be used in paste backfill in the underground workings, while the rest will be deposited in Brucejack Lake.”).

⁸⁵ Brucejack EA Report at 28.

⁸⁶ *Id.*

⁸⁷ JDS Energy & Mining Inc., Technical Report for the Tulsequah Chief Project of Northern British Columbia, Canada at. at 18-38, Tbl. 18.10 (Jan. 22, 2013).

⁸⁸ *Id.* at 18-44.

kilometers) upstream of the creek's confluence with the Tulsequah River.⁸⁹ A compacted earth-fill dam, 1.4 miles (2.2 kilometers) long and ultimately up to 30 feet (9 meters) tall, will contain the tailings.⁹⁰ On closure of the mine, the tailings impoundment will be drained, capped with soil, and re-vegetated.⁹¹

77. In the Stikine River watershed, the Red Chris Mine uses a wet dammed tailings impoundment. Two miles (three and one-half kilometers) northeast of the mine site, a Y-shaped valley has been dammed at each of its three arms by earth-fill embankments⁹² to contain an expected 300 million metric tons of mine tailings.⁹³ The valley straddles the Iskut and Klappan watersheds, both of which drain into the Stikine River.⁹⁴ For two of the dams, starter dams are planned to contain two years of tailings; the dams will then be raised on an annual basis to contain increasing amounts of tailings.⁹⁵ These will be centerline design dams.⁹⁶

78. The Schaft Creek Project could generate over 800 million metric tons of tailings.⁹⁷ These tailings will be impounded by rockfill embankments within the watershed of Skeeter Creek, a tributary of Schaft Creek, and thus the Stikine River.⁹⁸

⁸⁹ *Id.* at 18-38 (“The [tailings management facility] is located approximately 4 km upstream (north) of the main mine facilities on the east bank of the Shazah Creek.”); *id.* 5-2 (describing the site as “on the Shazah Creek close to its confluence with the Tulsequah River”).

⁹⁰ *Id.* at 18-38, 18-42.

⁹¹ *Id.* at 18-38.

⁹² Red Chris EA Application at 4-348.

⁹³ Klohn Crippen Berger Limited, *Tahltan Central Council: Red Chris Mine Site Review of Tailings Impoundment Design* at 4 (Oct. 2014), <http://tahltan.org/wp-content/uploads/2015/08/KCB-Red-Chris-Third-Party-Review.pdf>.

⁹⁴ Red Chris EA Application at 4-348.

⁹⁵ *Id.* at 3-108

⁹⁶ *Id.*

⁹⁷ P. W. Scannell, Stikine River Mining Activity Risk Assessment, Alaska Department of Fish and Game, Technical Report No. 10-06 at 75 (2012).

⁹⁸ *Id.* at 75-76; Tetra Tech, Feasibility Study on the Schaft Creek Project, BC, Canada at 18-19, 18-24 (Jan. 23, 2013) (Schaft Creek 2013 Feasibility Study).

79. The Galore Creek Project would produce acid-generating waste rock and tailings under water behind dams in a steep canyon.⁹⁹ By the completion of the mine's operating life the impoundment would be 3.9 square kilometers.¹⁰⁰

80. The KSM Mine's tailings facility is not located in a transboundary watershed. Tailings will be sent to an impoundment facility within the upper reaches of South Teigen Creek within the Nass River drainage.¹⁰¹ The impoundment will hold 2.3 billion metric tons of tailings.¹⁰²

81. I have reviewed the specifications of tailings dams at each of the mines described above. In my opinion, these dams demonstrate the factors that increase the likelihood of dam failure as a general matter. These dams must last for millennia, a timescale over which structural weaknesses and poor planning, if they exist, will likely become manifest. The dams would be constructed by mining companies without best practice guidance by public authorities. For example, the method of wet closure was adopted, despite the recommendation of the Mount Polley Commission to avoid such closures. Moreover, "safety" has not explicitly been made the primary consideration in the design, construction, operation, and closure of tailings dams, again an explicit recommendation of the Mount Polley Expert Panel.¹⁰³ Clear guidance needs to be given for design risk assessment physical stability (i.e. safety), operational priorities, and closure

⁹⁹ Galore Creek Comprehensive Study Report at 38; *see also* Galore Creek EA Application at 7-220 ("The effects of PAG waste rock will be controlled by submergence in the tailings and waste rock impoundment, adjacent to but separate from the tailings disposal area."); Scannell at 28.

¹⁰⁰ *Id.* at 10.

¹⁰¹ KSM EA Application at 4-194.

¹⁰² *Id.*

¹⁰³ I have written a critique of the changes made to the B.C. Mine Health Safety and Reclamation Code in response to the Mount Polley dam failure, in which I provide a detailed explanation of the failure of the B.C. Code to make safety the primary consideration in tailings dam design, construction, operation, and closure. *See* David M Chambers, *Comments on the Code Review Changes to Part 10, Mine Health Safety and Reclamation Code for Mines in British Columbia*, (Sept. 30, 2016).

considerations. Safety must be the primary (but not the only) concern in order to prevent future catastrophic tailings dam failures, and should be given more weight than other factors.

82. For this reason tailings dam failures are a real risk at the B.C. mines. Depending on its severity, a dam failure at Red Chris, Schaft Creek, Galore Creek, or the Tulsequah Chief Mine could release large volumes of tailings slurry or toxic contact waters streaming through the Stikine or Taku River watersheds, since each of these mines employs a wet closure. The consequences of a catastrophic failure at any of these mines would be severe, and Alaskans would probably receive no compensation to mitigate the impacts of such a failure.

VI. CONCLUSION

83. The B.C. Mines pose risks of pollution to downstream watersheds, both through the release of metals loaded contact waters in the normal course of operation, as well as through the possibility of an unplanned failure in their waste management or tailings impoundment system.

DATED: November 14, 2018.



David M. Chambers, Ph.D., P. Geop.

CENTER for SCIENCE in PUBLIC PARTICIPATION

224 North Church Avenue, Bozeman, MT 59715
Phone (406) 585-9854 / Fax (406) 585-2260 / e-mail: csp2@csp2.org
"Technical Support for Grassroots Public Interest Groups"



DAVID M. CHAMBERS, Ph.D., P. Geop.
Center for Science in Public Participation
224 North Church Avenue
Bozeman, MT 59715-3706

Phone: 406-585-9854
Fax: 406-585-2260
e-mail: dchambers@csp2.org
web: www.csp2.org

Dr. Chambers is the president of the Center for Science in Public Participation, a non-profit corporation formed to provide technical assistance on mining and water quality to public interest groups and tribal governments.

David Chambers has 40 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 25+ years he has served as an advisor on the environmental effects of mining projects both nationally and internationally. He has Professional Engineering Degree in physics from the Colorado School of Mines, a Master of Science Degree in geophysics from the University of California at Berkeley, and is a registered professional geophysicist in California (# GP 972). Dr. Chambers received his Ph.D. in environmental planning from Berkeley. His recent research focuses on tailings dam failures, and the intersection of science and technology with public policy and natural resource management.

Dr. Chambers is a current member of the federally chartered US Extractive Industries Transparency Initiative, and is also a frequent contributor of science & research informing further development of Natural Resource Canada's MEND (Mine Environmental Neutral Drainage) Program. He has been a member of the University of Alaska-Fairbanks School of Mineral Engineering Advisory Board; a member of the Western Governors' Association Abandoned Mine Waste Working Group; and, a member of the EPA's RCRA Policy Dialogue Committee, a group of industry, environmental and government representatives who worked to develop regulations for mining wastes under the authority of RCRA Subtitle D.

He has provided technical assistance to public interest groups and tribal governments on proposed, operating, and abandoned mines in Alaska, Arizona, California, Colorado, Idaho, Michigan, Minnesota, Missouri, Montana, Nevada, Oregon, South Carolina, South Dakota, Utah, Washington, Wisconsin, Canada (British Columbia, Ontario, Labrador, Yukon), Kyrgyzstan, and Northern Ireland. This assistance has included review of environmental impact studies and reclamation plans for underground and open pit mine design, seismic stability for tailings dams, waste rock facilities design, water quality monitoring, water treatment facility design, reclamation planning, and financial assurance for mine closure. He has also played a key role in efforts by the mining industry and NGOs to research and regulate marine mine waste disposal, and a joint industry-NGO international effort to develop a process to define and measure performance for responsible mining practices.

He is also a retired Navy captain (O-6), a Naval Flight Officer with two Vietnam carrier cruises and over 30 years of military service.

Education:

University of California, Berkeley		
Doctor of Philosophy - Environmental Planning		May 1985
University of California, Berkeley		
Master of Science - Geophysics		June 1976
Colorado School of Mines, Golden, Colorado		
Mineral Engineer - Physics		May 1969

Working Affiliations:

- International Conference on Acid Rock Drainage (ICARD), technical paper referee for 2012 conference.
- International Network on Acid Production (INAP) – Global Acid Rock Drainage (GARD) Guide Advisory Committee, 2009
- University of Alaska, Fairbanks, School of Mineral Engineering Advisory Board (1994-2001)
- Department of Energy - Integrated Non-Thermal Systems Review - Tribal and Stakeholder Working Group (1995-1996)
- Western Governors' Association Mine Waste Working Group (1993-1995)
- Alaska Minerals and Energy Education Program - Executive Review Committee (1992-1995)
- EPA Policy Dialog Committee on Mining Waste (1991-1992)
- United States Navy (1970-2000), Naval Flight Officer, Captain (O-6, Reserve-retired)

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

PUBLICATIONS / PAPERS

“Independent investigation of reclamation at exploration drill holes at the remote Pebble copper prospect, Alaska,” Kendra Zamzow and David M Chambers, Proceedings of the 13th International Mine Water Association Congress, 2017

“In the Dark Shadow of the Supercycle Tailings Failure Risk & Public Liability Reach All Time Highs,” Lindsay Newland Bowker, David M Chambers, MDPI Journal Environments 2017, 4, 75; doi:10.3390/environments4040075, October 21, 2017

“Mine Tailings Storage: Safety Is No Accident.” Roche, C., Thygesen, K., Baker, E., Bastos, A., Bernaudat, L., Blyth, S., Sharon Brooks, S., Chambers, D., Coumans, C., Deguignet, M., Fourie, A., Lottermoser, B., McLellan, B., Phillips, J., Reinhardt, W., Valix, M. Wisdom, T. A UNEP Rapid Response Assessment. United Nations Environment Programme and GRID-Arendal, Nairobi and Arendal, www.grida.no, November, 2017, ISBN: 978-82-7701-170-7

[“Root Causes of Tailings Dam Overtopping: The Economics of Risk & Consequence,”](#) Lindsay Newland Bowker and David M. Chambers, Protections 2016, Colorado State University, 8Sep16

[“Post-Mount Polley Tailings Dam Safety in Transboundary British Columbia,”](#) David M. Chambers, On behalf of Earthworks, Rivers Without Borders, Mining Watch Canada, Southeast Alaska Conservation Council, Inland Passage Waterkeeper, Friends of the Stikine Society, David Suzuki Foundation, Sierra Club BC, Pacific Wild, Skeena Wild, Watershed Watch Salmon Society, Canadian Parks and Wilderness Society, Clayoquot Action, and the Wilderness Committee, March 2016.

[“AFS Position Paper and Policy on Mining and Fossil Fuel Extraction,”](#) Robert M. Hughes, Felipe Amezcua, David M. Chambers, Wesley M. Daniel, James S. Franks, William Franzin, Donald MacDonald, Eric Merriam, George Neall, Paulo dos Santos Pompeu, Lou Reynolds & Carol Ann Woody, Fisheries, Vol. 41, No. 1, January 2016

[“The Risk, Public Liability, & Economics of Tailings Storage Facility Failures,”](#) Lindsay Newland Bowker and David M Chambers, July 21, 2015

[“A Review of the Report on Mount Polley Tailings Storage Facility Breach, Independent Expert Engineering Investigation and Review Panel,”](#) David M Chambers, Feb15

[“Long-Term Risk of Tailings Dam Failure,”](#) David M Chambers, Alaska Park Science, Volume 13, Issue 2, National Park Service, Department of Interior, Anchorage, AK, pp. 54-59, December, 2014

[“Options for Defining Environmental “Go/No-Go” Zones for Mines,”](#) David Chambers, 2Jan14

[“Long Term Risk of Releasing Potentially Acid Producing Waste Due to Tailings Dam Failure,”](#) David M Chambers, Proceedings of the 9th International Conference on Acid Rock Drainage (ICARD 2012), Ottawa, ON, May, 2012

[Bristol Bay’s Wild Salmon Ecosystems and the Pebble Mine: Key Considerations for a Large-Scale Mine Proposal,](#) David Chambers, Robert Moran, Lance Trasky, produced in partnership by Wild Salmon Center and Trout Unlimited, January, 2012

[“Long-Term Risks of Tailings Dam Failure,”](#) Chambers, D. M., and B. Higman, Center for Science in Public Participation, Bozeman, MT, (letter peer review by USEPA), October, 2011

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

"Perpetual Water Treatment for Mines," David M Chambers, Water Today, Volume 3, Issue 4, August, 2010, pp. 58-59.

Brief of Amici Curiae in Support of Southeast Alaska Conservation Council v. Coeur Alaska and the State of Alaska, in the Supreme Court of the United States, Nos. 07-984, 07-990; Chambers, D; Coumans, C; and, Woody, C.A., November, 2008.

"Pebble Mine Engineering Geology Considerations," Center for Science in Public Participation, David Chambers, September, 2007.

"Alaska Large Mine Reclamation Bonding – 2005," David M Chambers, Proceedings of the Billings Land Reclamation Symposium, Billings, MT, June, 2006.

Framework for Responsible Mining: A Guide to Evolving Standards, Marta Miranda, David Chambers, and Catherine Coumans, October 19, 2005.

"The Costs of Mining: Underwriting Mine Closure Risk," David M. Chambers, in The Corporate Ethics Monitor, Volume 17, Issue 1, January-February 2005 Published by Ethicscan Canada Limited

"Some Environmental Concerns with Small Scale Mining," David M Chambers, in the Centre for Resource Studies, Queen's University, CRS Perspectives, Number 52, January 1996, p. 13-14.

"An ElectroMagnetic Array Profiling (EMAP) Case Study," D.R. Word, R. Goss, and D.M. Chambers, 1986 Technical Abstracts, Society of Exploration Geophysicists, Tulsa, Oklahoma.

"Mineral Potential Hidden Under Resource Allocation Conflicts," David M Chambers, in Forest Planning, vol. 6, no. 3, June 1985, p. 11-15.

The Use of Mineral Resource Information for Minerals Planning on National Forest Lands, David M Chambers, Ph.D. Dissertation, U.C. Berkeley, May 85

"Government Agencies Face Dilemma in Mineral Resource Planning," David M Chambers, in American Planning Association Northern News, vol.5, no. 14, Nov/Dec 1984.

Planners Guide to Geothermal Development in California, W.S. Yen, D.M. Chambers, et al., Lawrence Berkeley Laboratory, Sep. 1980.

PROFESSIONAL REPORTS

2017

Comments on Preliminary Draft Permit AK0053341, Pogo Mine, to the Alaska Department of Environmental Conservation, 9Feb17

Comments on MEND Tailings Study Version 2, for MiningWatch Canada, 14Apr17

Comments on IPRP Report Clinton Creek, for Tr'ondëk Hwëch'in First Nation, 20Apr17

Analysis of Cemented Paste Backfilling at Rock Creek and Montanore, for Earthworks, 7Aug17

Report on Sisson Project Consistency with Mt Polley Expert Panel Recommendations, for MiningWatch Canada, 11Aug17

Comments on MEND Tailings Study Version 3, for MiningWatch Canada, 20Sep17

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Submissions on groundwater impact analysis of the Central Queensland Coal Project, 5Dec17

2016

Review of the Cemented Tailings Facility seepage, and the proposal for Land Application of Treated Effluent for the Black Butte Copper Project, for Montana Trout Unlimited, 22Jan16

Review of the Casino Mine Supplemental Information Report B, for the Tr'ondëk Hwëch'in Government, 26Jan16

Comments on the Draft Environmental and Socio-economic Effects Statement Guidelines for the Casino Mine, for the Tr'ondëk Hwëch'in Government, 14Apr16

Comments on the Rock Creek Mine Draft Supplemental Environmental Impact Statement, Zamzow & Chambers, for Earthworks and the Rock Creek Alliance, 18Apr16

Comments on Sisson Project Comprehensive Study Report, to the Canadian Environmental Assessment Agency, for Conservation Council of New Brunswick, 4May16

Comments on the Draft Environmental Assessment Palmer Exploration Project Constantine North, Inc., to the Bureau of Land Management, Glennallen, Alaska, Field Office, 23May16

Comments on the Donlin Mine Draft Environmental Impact Statement, to the Army Corps of Engineers, Zamzow and Chambers, 24May16

Comments on the Proposed Amendment to the Environmental Assessment Certificate #M05-02 granted to Red Chris Development Company Ltd. (Proponent) on August 24, 2005, to British Columbia Environmental Assessment Office, 7Jul16

Resolution Copper EIS Scoping Comments, to US Forest Service for Arizona Mining Reform Coalition, 8Jul16

Comments on the Code Review Changes to Part 10, Mine Health Safety and Reclamation Code for Mines in British Columbia, to the British Columbia Ministry of Energy and Mines, on behalf of the Sierra Club of BC and Northern Confluence, 9Aug16

Comments on the Red Dog Mine Reclamation Plan and Financial Assurance Calculations, to the Alaska Department of Natural Resources, 12Sep16

Investigation of Reclaimed Drill Sites, Pebble Prospect, 2016, Kendra Zamzow and David Chambers, 3Nov16

Comments on the Code Review Changes to Part 10, Mine Health Safety and Reclamation Code for Mines in British Columbia, 30Sep16

Lucky Minerals Exploration Draft Environmental Assessment Comments, to Montana Department of Environmental Quality, for Greater Yellowstone Coalition, 12Nov16

2015

Comments on the Draft Permit GP POA 2014-55 Mechanical Placer Mining Activities within the State of Alaska, to the Army Corps of Engineers, 12Jan15

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on Preliminary Draft Permit AKG370000 Mechanical Placer General Permit, to the Alaska Department of Environmental Conservation, 6Feb15

Comments on Casino Mine Proposal YESAB Adequacy Review, for the Tr'ondëk Hwëch'in Government, 20Feb15

Comments on the Rasmussen Valley Draft EIS, to the BLM Pocatello Field Office, for the Greater Yellowstone Coalition, 2Nov15

Comments on the Final Environmental Impact Statement (FEIS) NorthMet Mining Project and Land Exchange, for the Minnesota Center for Environmental Advocacy, 20Dec15

2014

Comments on Rosemont Mine Final Environmental Impact Statement, for Save the Scenic Santa Ritas, 6Jan14

Comments on the EIA Report of Vaghena Bauxite Mining Project, for the Landowners Advocacy and Legal Support Unit, Public Solicitor's Office, Solomon Islands, 22Jan14

Comments on: Preliminary Draft Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity, Permit Number AKR060000, 3Feb14, to the Alaska Department of Environmental Conservation

Comments on: The Environmental Impact Assessment Report and Environmental Management Programme for the Proposed Platreef Underground Mine, for Lawyers for Human Rights, Johannesburg, South Africa, and Environmental Defender Law Center, Bozeman, MT, 6Feb14

Comments on Greens Creek Mine Draft Permit AK0043206, to the Alaska Department of Environmental Conservation, 30May14

Comments on ACOE Placer Draft General Permit GP POA 2014-55, 20Jun14

The Potential for Acid Mine Drainage and other Water Quality Problems at Modern Copper Mines Using State-of-the-Art Prevention, Treatment, and Mitigation Methods, a report by the Center for Science in Public Participation, July 24, 2014.

Comments on the EPA Bristol Bay Watershed Assessment Proposed Determination, to USEPA, Washington, DC, 15Sep14

Comments on: Preliminary (Second) Draft Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity, Permit Number AKR060000, 1Oct14

Comments on Niblack Preliminary Draft APDES Permit AK0053708, to the Alaska Department of Environmental Conservation, 9Dec14

2013

Comments on the Greens Creek Mine Preliminary Draft Permit (AK0043206) Fact Sheet, to the Alaska Department of Environmental Conservation, 14Feb13

Comments on Draft Niblack Exploration Solid Waste Management Permit No. 2013DB0001, to the Alaska Department of Environmental Conservation, 21Feb13

Comments on Scoping for the Donlin Draft EIS, to the Army Corps of Engineers, 29Mar13

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on Sisson Brook Environmental Impact Assessment, to the Canadian Environmental Assessment Office, 7Oct13

Comments on KSM (Kerr-Sulphurets-Mitchell) Project Environmental Impact Statement, to the BC Environmental Assessment Office, 18Oct13

2012

Comments on Rosemont Mine DEIS, to the US Forest Service for Mountain Empire Action Alliance, 13Jan12

Comments on Rock Creek Mine Reclamation & Closure Plan, to the Alaska Department of Natural Resources, 20Jan12

Alaska Large Mine Comparison Report, Levit & Chambers, Feb12

Comments on Pogo Mine Amended Plan of Operations for changes to the Dry Stack Tailings Facility, to the Alaska Department of Natural Resources, 6Apr12

Comments on the Draft Environmental Impact Statement Greens Creek Mine Tailings Disposal Facility Expansion, to the US Forest Service and Army Corps of Engineers, 4Jun12

Peer Review Comments, PLP White Papers #1, #2, #3, to USEPA, 23Oct12

Comments on "Preliminary Decision: Competitive Coal Lease Sale in the Canyon Creek Area, Alaska, ADL 553937, Alaska Department of Natural Resources, 20Nov12

2011

Comments on Greens Creek APDES Renewal, to the Alaska Department of Environmental Conservation, 2May11

Comments on the Kensington APDES Renewal, to the Alaska Department of Environmental Conservation, 8Jun11

Comments on Wharf Expansion Project Mine Permit Application, to the South Dakota Department of Environment & Natural Resources, Pierre, SD, 18Aug11

Comments on Flambeau Mining Company Application to Convert a Detention Basin, to Wisconsin Department of Natural Resources for the Wisconsin Resources Protection Coalition, 30Aug11

Comments on Landusky Metals and Cyanide TMDLs and Framework Water Quality Restoration Plan, to the Montana Department of Environmental Quality, 9Sep11

Wishbone Hill Coal Mine Permit 2011 SMCRA Permit Documents 01-89-796 and 02-89-796, Zamzow, Monohan, Chambers, to the Alaska Department of Natural Resources, 15Nov11

Review of Greens Creek Mine APDES Mixing Zone Modeling, for the Southeast Alaska Conservation Council, 18Nov11

Review of the Pogo Mine Solid Waste Permit and Bond Calculations, to the Alaska Department of Environmental Conservations, 30Dec11

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

2010

Comments on the NorthMet Project, to the Minnesota Department of Natural Resources and the US Army Corps of Engineers, 27Jan10

Greens Creek Tailings Expansion Scoping Comments, to the US Forest Service, 16Nov10

Pogo Mine NPDES Renewal Comments, to USEPA Region 10, 24Nov10

2009

Comments on the Voisey's Bay mine 2007 Freshwater Monitoring Summary Report, to the Environment Division, Nunatsiavut Government, 2Jan09

Comments on TVX Mineral Hill Bond Release, to the Montana Department of Environmental Quality, 19Jan09

Comments on the Proposed Revisions to Alaska's Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances - Chronic Aquatic Life Criterion for Aluminum, to the Alaska Department of Environmental Conservation, 19Jan09

Comments on the Aqqaluk Project Draft Environmental Impact Statement, to USEPA, Region 10, 3Feb09

Comments on the US Environmental Agency Plans to Re-issue a Wastewater Discharge Permit to Teck Cominco Alaska, Red Dog Mine, to USEPA, Region 10, 3Feb09

Comments on Draft Montanore Project EIS – Review of the Seismic Safety Considerations for the Montanore Tailings Dam, to Montana DEQ and Kootenai National Forest, 20May09

Comments on the Draft Reclamation and Waste Permits for Red Dog Mine, to Alaska Department of Natural Resources and Alaska Department of Conservation, 19Aug09

Comments on Chuitna Coal Project Geology Baseline Information, PacRim Coal, L.P., to Cook Inletkeeper, 20Aug09

2008

Comments on New World Project Site-Wide Long Term Operations and Maintenance Plan, to Gallatin National Forest, 29Feb08

Comments on Rock Creek Class V UIC Permit, to Region 10 EPA, 14Mar08

Comments on Montana Tunnels Draft MPDES Permit, to Montana Department of Environmental Conservation, 1Apr08

Comments on Aqqaluk Draft SEIS Chapter 3, for Maniilaq Association, 22May08.

Comments on Site-Specific Standard for Copper for Pinto Creek, to the Arizona Department of Environmental Quality, 30May08.

Report on Groundwater and Surface Water Contamination at the Flambeau Mine, David M Chambers, Kendra Zamzow, June 18, 2008.

Review of the Mt. Milligan Project draft Environmental Assessment, Dr. David Chambers, Dr. Kendra Zamzow, Ms. Carrie Slanina and Amy Crook, for the Nak'azdli First Nation, Fort St. James, BC, June 19, 2008.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

2007

Comments on Draft Permit for Treated Mine Water and Storm Water from the Buckhorn Mine, to the Washington Department of Ecology, 2Jan07.

Comments on New World Draft Adit Discharge EE/CA, to the US Forest Service, 26Feb07.

Comments on Draft Small Suction Dredge Permit AKG-37-5000, to USEPA, 26Feb07.

Pebble Resource Estimate Memo, for Bristol Bay Alliance, 20Mar07

Comments on Niblack Project, to the State of Alaska and the Army Corps of Engineers, 22May07.

Comments on Revised Draft Permit for Treated Mine Water and Storm Water from the Buckhorn Mine, to the Washington Department of Ecology, 22Jun07.

Comments on Montana Tunnels Draft MPDES Permit, to the Montana Department of Environmental Quality, 17Jul07.

Comments on Draft Environmental, Health and Safety Guidelines for Mining, to International Finance Corporation, Environment and Social Development Department, Aug07.

Comments on Voisey's Bay Freshwater Monitoring 2006 Summary Report, for the Nunatsiavut First Nation, Goose Bay, Labrador, 20Dec07.

2006

Comments on the Proposed Upstream-type Dam Expansion for the Kettle River Tailings Disposal Facility, to the Washington Department of Ecology, Dam Safety Office, 22Feb06.

Comments on the Smoky Canyon Draft EIS, Greater Yellowstone Coalition, 15Mar06.

Eagle Project Application and EIA Comments, National Wildlife Federation, Ann Arbor, MI, 8May06.

Comments on the Smoky Canyon Mine EE/CA, to USDA Forest Service for GYC, 17Jul06.

Comments on POA-2006-742-4 (Rock Creek and Big Hurrah mines), to U.S. Army Corps of Engineers, 23Jun06.

Comments on Reclamation Plan and Waste Management Permit (Rock Creek and Big Hurrah mines), to Alaska Department of Natural Resources, 5Jul06.

Comments on 2006 Proposed Water Quality Standard for Natural Condition, to the Alaska Department of Environmental Conservations, 29Sep06.

2005

Comments on the Application Supplement for the Red Chris Porphyry Copper-Gold Mine Project, to BC Environmental Assessment Office, with Amy Crook, 19Jan05.

Technical Review - Code of Practice for the Discharge of Produced Water from Coalbed Gas Operations in British Columbia, prepared by Tom Myers, Ph.D; David Chambers, Ph.D; and, Amy Crook, M.S., for West Coast Environmental Law Center, January 25, 2005.

Comments on Heath Steele Tailings Area: Field Assessment, for Natural Resources Canada (MEND), 5May05.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on the Pend Oreille Mine June 2005 AKART Analysis Report, to Washington Department of Ecology, 15Jul05.

Comments on: Pre-Mining Water Quality Evaluation of Swift Gulch, Landusky, MT – Draft Release, for the Indian Law Resource Center, 9Sep05.

Comments on the Midnite Mine RI/FS, to SHAWL Society, 26Oct05.

Comments on the Nixon Fork Mine, Environmental Assessment (AK-040-04-EA-022), to the Bureau of Land Management, 15Nov05.

Technical Review Environmental and Social Impact Assessment Ahafo South Project (Ghana), Stuart M. Levit and David Chambers, December 9, 2005

Comments on the Buckhorn Mountain Project Draft Supplemental Environmental Impact Statement, to Washington Department of Environmental Quality, 14Dec05.

2004

Comments on Covers for Reactive Tailings Located in Permafrost Regions Review, December 2003 Draft, for Natural Resources Canada (MEND), 16Jan04.

Comments on Design, Construction and Performance Monitoring of Cover Systems for Waste Rock and Tailings, September 2003 Draft, for Natural Resources Canada (MEND), 1Mar04

Comments on the Kensington Gold Project Draft NPDES Permit, to EPA Region 10, 27Jul04.

Draft GRI / ICMM Mining and Metals Sector Supplement Public Comments, to Global Reporting Initiative / International Council on Mining and Metals, for EarthWorks/CSP2, 23Aug04

Comments on Mining Certification Evaluation Project Working Paper #1, to World Wildlife Fund (Australia), for EarthWorks/CSP2, 7Sep04

Comments on Review of Disposal Options for Acidic Drainage Treatment Sludge, Janice Zinck, July 31, 2004 Draft, for Natural Resources Canada (MEND), 7Sep04

Comments on Paste Backfill Geochemistry - Influence on Mine Water Quality, Draft Report, Mehling Environmental Management, Inc., for Natural Resources Canada (MEND), 21Oct04.

Comments on Greens Creek Mine Draft NPDES Permit Number AK-004320-6, to USEPA Region 10, 29Nov04

2003

Review of the Technical Aspects of the Sepon Project (Laos) Environmental and Social Impact Assessment Addendum Volume 2: Main Report Text, for Oxfam International, 3 Jan 03.

Technical Comments on the Rosia Montana (Romania) Feasibility Study and the Rosia Montana Project Description, for CEE Bankwatch, Budapest, 13 Jan 03.

Comments on Grouse Creek Engineering Evaluation/Cost Analysis, to the USDA-Forest service and the Environmental Protection Agency on behalf of the Idaho Conservation League, 28 Jan 03.

Review of the Technical Aspects of the Sepon Project (Laos) Environmental and Social Impact Assessment Addendum Volume 2: Main Report Text, for Oxfam International, 29 Jan 03.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on Volume IV – Supplemental Plan Information, Brewery Creek Mine, for the Tr'ondëk Hwëch'in, Hän Nation, Dawson City, Yukon, 6 Feb 03.

Monitoring Stations in Drainages Leading Toward the Fort Belknap Reservation, prepared for the Western Environmental Law Center, 25 Feb 03.

Montcalm Project Mine Water Treatment Pond Expansion Support Document, comments prepared for Partnership for Public Lands, Don Mill, Ontario, 6 Mar 03.

Letter on the Proposed Changes to the CBJ Mining Ordinance, to the Juneau City Assembly, 25 Apr 03.

Technical Comments on the Pogo Mine Draft EIS, to EPA, Alaska DNR and DEC, 13 May 03.

Comments on Draft Reclamation Bond Estimating and Administration Guide, USDA Forest Service, to USFS, 16 Jun 03.

Technical Comments on the Greens Creek Mine Draft EIS, to EPA, USFS, Alaska DNR and DEC, 30 Jun 03.

Comments on the Initial Plan of Operations, Buckhorn Mountain Project, Crown Resources Corporation, to Okanagan Highlands Alliance, Mineral Policy Center and Wash PIRG, 9 Jul 03.

Comments on the Greens Creek Tailings and Production Rock Site 2002 Annual Report, to the Alaska Department of Environmental Conservation, the Environmental Protection Agency, and to Kennecott Greens Creek Mining Company, 5 Aug 03.

Comments on the Pogo Mine Final EIS, to EPA, Alaska DNR and DEC, 17 Oct 03.

Comments on Proposed Industrial Wastewater Permit Number ST 8033 to Echo Bay Minerals, to the Washington Department of Ecology, 13 Nov 03.

Comments on the Draft NPDES Permit No. WA-0001317 – Pend Oreille Mine Project, to the Washington Department of Ecology, 10 Dec 03.

2002

Comments on Application for Amendments to the True North Mine Operating Plans, submitted to the Alaska Department of Natural Resources, 19 Feb 02.

Status of Montana Pollution Discharge Elimination System (MPDES) Permit, and the accompanying Monitoring Plan for the Zortman and Landusky mines, to the Fort Belknap Community Council, 2 Mar 02.

Response to Comments on the 2001 Decommissioning and Reclamation Plan, Brewery Creek Mine, for the Tr'ondëk Hwech'in, Hän Nation, Dawson City, Yukon, 8 Mar 02.

Review of the Technical Aspects of the Sepon Project Environmental and Social Impact Analysis (ESIA) and Environmental Management Plan (EMP), for Oxfam International, 29 Mar 02.

Comments on NEPA "General Analysis" for Small Mining Projects, USFS Seward Ranger District, Alaska, 22 Apr 02.

Review of MMSD Draft Report, to the Global Mining Campaign, 28 Apr 02

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on Working Document Number 2, The Management of Waste Resulting from Prospecting, Extraction, Treatment and Storage of Minerals, European Commission, Brussels, 4 February 2002, for MineWatch, London, 6 May 02

Comments on 2002 Work Plan for reclamation at the New World Mine, Montana, submitted to the US Forest Service, 27 Jun 02.

Comments on Como Basin/Glengarry Adit/Fisher Creek Draft EE/CA at the New World Mine, submitted to the US Forest Service, 3 Jul 02.

Comments of the Draft NPDES Permit for the Beartrack Mine, submitted to the USEPA Region 10, 11 Jul 02.

Comments on Draft Final Expanded Engineering Evaluation/Cost Analysis for the McLaren Tailings Site, Cooke City, to the Montana Department of Environmental Quality, 12 Jul 02.

Comments on Draft Volume IV – 2001 Decommissioning and Reclamation Plan Supplemental Technical Information, Brewery Creek Mine, for the Tr'ondëk Hwech'in, Hän Nation, Dawson City, Yukon 4 Aug 02.

Comments on Proposed Modification of the National Pollutant Discharge Elimination System (NPDES) Permit to Discharge Pollutants A.J. Mine, to Region 10 EPA, Alaska Department of Environmental Conservation, and Alaska Division of Governmental Coordination, 9 Aug 02.

Comments on the Rosia Montana (Romania) Feasibility Study, to CEE Bankwatch Network, Budapest, Hungary, 10 Sep 02.

Comments to the Montana Board of Environmental Review on a Proposed Change to ARM 17.24.102(5) {Bond Sureties for Metal Mine Reclamation}, 18 Sep 02.

Comments on the Rosia Montana Feasibility Study, CEE Bankwatch Network, 18 Sep 02.

Technical Comments on the Rosia Montana (Romania) Feasibility Study and the Rosia Montana Project Description, CEE Bankwatch Network, 18 Dec 02.

2001

Comments on the Draft Report on the Landusky Mine's Hydrologic Impact to King Creek and Swift Gulch, for Fort Belknap Indian Council, 18 Jan 01.

Mineral Hill Mine Draft EIS Comments, for Greater Yellowstone Coalition, 19 Mar 01.

Comments on Effluent Treatment and Land Application Water License Submission, Brewery Creek Mine, for Tr'ondëk Hwëech'in, Hän Nation, Dawson City, Yukon, 18 May 01.

Mineral Hill Mine Bond Calculation Comments, to the Montana Department of Environmental Quality for Greater Yellowstone Coalition, 19 Jun 01.

Comments on the Zortman-Landusky Mine Reclamation Plan Draft SEIS, to the Bureau of Land Management and MT Department of Environmental Quality, 26 Jul 01.

Response to Comments on Effluent Treatment and Land Application Water License Submission, Brewery Creek Mine, to the Tr'ondëk Hwëech'in, Hän Nation, Dawson City, Yukon, 9 Aug 01.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on New World Mine/McLaren Pit Engineering Evaluation/Cost Analysis, to Montana Department of Environmental Quality, 29Aug 01.

Comments on a proposed silica mine in Northern California, to the Cherokee Preservation Society, 7 Sep 01.

Comments on Zortman-Landusky Water Quality Monitoring Data, Jan – Jul 2001, to Montana Department of Environmental Quality, for Island Mountain Protectors, 13 Sep 01.

Comments on Greens Creek Mine Reclamation Plan; Attachment A - Detailed Reclamation Plan With Cost Estimates, July 31, 2001, DM Chambers and JR Kuipers, to the Alaska Department of Environmental Conservation, 18 Sep 01.

Response to Kennicott Greens Creek Mining Company on the Detailed Reclamation Plan with Cost Estimates, DM Chambers and JR Kuipers, to the Alaska Department of Environmental Conservation, 19 Oct 01.

Comments on the 2001 Decommissioning and Reclamation Plan, Brewery Creek Mine, Viceroy Minerals, for the Tr'ondëk Hwëech'in, Hän Nation, Dawson City, Yukon, 20 Nov 01.

2000

Review of the Bathurst Minerals and Energy Resource Assessment, for the Canadian Nature Federation, Jan00.

Comments on the Landusky Land Application Area Report, to the Montana Department of Environmental Quality, on behalf of the Fort Belknap Community Council, Feb00.

Comments on the King Creek Tailings Removal Draft Scope of Work, to the US Army Corps of Engineers on behalf of the Fort Belknap Community Council, Feb00.

Comments on the Alaska General Mechanical Placer NPDES Permit, to the USEPA, Mar00.

Comments on the Upper Blackfoot River Temporary Water Quality Standards, to the Montana Department of Environmental Quality, Board of Environmental Review, Mar00.

Comments on the Pend Oreille Mine Draft EIS, to the Washington Department of Ecology, Mar 00.

Comments on the ARD Technical Report for the Greens Creek Mine, Admiralty Island National Monument, Alaska, for the Southeast Alaska Conservation Council, Apr 00.

Comments on the Solid Waste Permit for the Greens Creek Mine, Admiralty Island National Monument, Alaska, to the Alaska Department of Environmental Conservation, Apr 00.

Comments on Wabush Lake, Labrador, Tailings Disposal Proposal, for Innu Nation, Jun 00.

Illinois Creek Mine Land Application Disposal Permit Comments, to the Alaska Department of Environmental Conservation, Jun 00.

Fort Knox Mill Permit Revision Comments, to the Alaska Department of Environmental Conservation and Alaska Department of Natural Resources, for the Northern Alaska Environmental Center, Aug 00.

Illinois Creek Waste Disposal Permit and Reclamation Plan Comments, to the Alaska Department of Environmental Conservation, Aug 00.

Comments on Candy Branch Placer Mine Operating Plan, for South Carolina Forest Watch, 15 Sep 00.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Comments on the Draft Reclamation Plan for the Greens Creek Mine, for the Southeast Alaska Conservation Council, 6 Oct 00.

Comments of the Greens Creek Mine Solid Waste Permit, to the Alaska Department of Environmental Conservation, Dec 00.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

PRESENTATIONS

2017

Presentation on Rock Creek Mine tailings impoundment design, to the Rock Creek Alliance, Sandpoint, ID, 24Aug17

Presentation on Rock Creek Mine tailings impoundment design, to the Bonner County (Idaho) Commission, Sandpoint, ID, 24Aug17

Presentation on Rock Creek Mine tailings impoundment design, to the Pend Oreille Lakes (Idaho) Commission, Sandpoint, ID, 25Aug17

2016

Pebble Panelists: Rick Halford, Wayne Nastri, David Chambers, Milo Atkinson, Heidi Kritz, Peter VanTuyn, Tom Tilden, Western Alaska Science Interdisciplinary Conference, Dillingham, AK, 10Mar16

Presentation at Simms Fishing meeting on Black Butte mine, Bozeman, MT, 22Apr16

Presentation on Large Tailings Dam Failures at Prince of Wales Mining Symposium, Klawock, AK, 26Apr16

Presentation on Tailings Dam Overtopping at Protections 2016, Colorado State University, Ft Collins, CO, 8Sep16

Presentation on Tailings Dam Failures, Western Mining Action Network Meeting, San Carlos, AZ, 19Nov16

2015

Presentation on "Expert Panel Report on the Mt Polley TSF Dam Failure," for WMAN, teleconference, 17Mar15

Panel: Save Our Salmon and United Tribal Transboundary Working Group, "Stories & Science of Our Transboundary Rivers," Juneau, AK, 3Apr15Presentation on "Tailing Dam – Types & Lessons," for the Takshanuk Watershed Council, Haines, AK, 7Apr15

Presentation on "Tailing Dam – Types & Lessons," for the Takshanuk Watershed Council, Klukwan, AK, 8Apr15

Panel: InfoMine Mine Water Solutions Conference, Vancouver, BC, "Bridge Over Troubled Waters" - Technical / Community Information Divide, 14Apr15

Panel: "Prioritization and Best Available Techniques," at Reclaiming the Sierra 2015 Conference, for The Sierra Fund, Sacramento, CA, 21Apr15

Presentation on "Standards for Responsible Mine Reclamation," at Reclaiming the Sierra 2015 Conference, for The Sierra Fund, Sacramento, CA, 21Apr15

"The Risk, Public Liability, & Economics of Tailings Storage Facility Failures," Lindsay Newland Bowker & David M Chambers, accepted for publication and presentation at the 2015 Northern Latitudes Mining Reclamation Workshop, Juneau, AK, 2Sep15

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Presentation on The Risk of Tailings Storage Facility Failures at the Global Energy, Mines and Markets (GEMM) Dialogue Initiative, Vancouver, 14Oct15

Presentation: Tailings Dam Failure History, BIA Providers Conference Presentation – Anchorage, AK 3Dec15

2014

Long-Term Risk of Tailings Dam Failure, presentation to the Alaska Chapter of the American Fisheries Society, Juneau, AK, 24Oct14

Environmental Risks Posed by Transboundary Mines, for Salmon Without Borders, meetings in: Juneau, AK, 24Oct14; Sitka, AK, 27Oct14; Wrangell, AK, 28Oct14; Petersburg, AK, 29Oct14; Ketchikan, AK, 30Oct14.

2013

Presentation to the University of Alaska Fairbanks OLE! Course on Pebble Mine Technical Concerns, Anchorage, 7Mar13

Presentation to Lynn Canal Conservation on Alaska Large Mines, Haines, AK, 18Apr13

2012

Presentation on Alaska mining to the Alaska Conservation Foundation Board, in Seattle, WA, 2Feb12

Presentation on Chuitna Coal Reclamation, at the Silverbow Inn in Juneau, 1Mar12

Presentation at Western Alaska Interdisciplinary Science Conference, Dillingham, on Long Term Risk of Releasing Potentially Acid Producing Waste Due to Tailings Dam Failure, Dillingham, AK, 30Mar12

International Conference on Acid Rock Drainage (ICARD), Opening Plenary Panel Presentation, Ottawa, ON, 22May12

Session Chair, Social License, International Conference on Acid Rock Drainage (ICARD), Ottawa, ON, 23May12

Presentation on Long Term Risk of Releasing Potentially Acid Producing Waste Due to Tailings Dam Failure, Science & Public Policy, An Alaska Case Study, International Conference on Acid Rock Drainage (ICARD), Ottawa, ON, 23May12

2011

Presentation on responsible mining at the invitation of the City and Borough of Juneau, AJ Mine Advisory Committee, Juneau, AK, 30Mar11

Presentation “Should Lakes be Used for Mine Waste Disposal?” at the American Fisheries Society annual meeting, Seattle, WA, 6Sep11

2010

Public Presentation on Responsible Large-Scale Mining: Global Perspectives at the Keystone Center Dialogue, December 3, 2010, University of Alaska Anchorage Consortium Library

Presentation on Pebble Mine to a joint meeting of the Senate Resources and House Fisheries Committees of the Alaska Legislature, Juneau, AK, 19Mar10.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

2009

Public presentation on analyzing the impacts from mining at the Kasaan Mining Symposium, Craig, AK, 7May09

Presentation on titanium mining to the Yakutat Tlingit Tribal Council, 11May09

Presentation to the Kuskokwim River Watershed Council on “Standards and Guidelines for Responsible Mining, Aniak, AK, 7Aug09

Public presentation on Responsible Mining to the Minnesota Environmental Initiative Forum, St Paul, MN, 15Sep09

Presentation to the Alaska Board of Fisheries on Pebble Mine risks, Anchorage, AK, 5Dec09

Presentation to members of the Alaska Legislature in Juneau on the potential environmental impacts of the Pebble mine, 17Feb09

2008

Presentation on the Pebble mine at the Western Alaska Interdisciplinary Science Conference, University of Alaska Fairbanks, Dillingham Campus, 4Apr08

Presentation on the Pebble mine to the American Society of Fisheries, Alaska Chapter, in Anchorage, 29Oct08

Presentations (3) at Indigenous Environmental Network (IEN) meeting on Fond du Lac Reservation, MN, 19-21Nov08

2006

Northern Alaska Environmental Center and the University of Alaska Natural Resource and Agricultural Science School Mining Panel, "Exploration in the Interior and Tangle Lakes," Wednesday, 26Apr06, Fairbanks, AK.

"Alaska Reclamation Bonding 2005," Mine Environmental Neutral Drainage (MEND) Maritimes Workshop, Halifax, NS, 23May06.

"Alaska Reclamation Bonding 2005," Billings Land Reclamation Symposium, Billings, MT, 5Jun06.

"Long Term Water Quality Concerns at the Rock Creek and Big Hurrah Mines," public presentation in Nome, AK, 4Oct06.

"Alaska Reclamation Bonding 2005," National Orphaned/Abandoned Mines Initiative Workshop, Winnipeg, Manitoba, 26Oct06.

2005

"Alaska Reclamation Bonding 2005," EPA "Hard Rock 2006" Conference in Tucson, 14Nov06.

Presentations on Acid Mine Drainage to the Indigenous Mining Conference, Edmonton, AB, 28Jul05; and, on Financial Assurance for Mines, 29Jul05.

Presentation on Pebble mine to University of Alaska, School of Fisheries and Ocean Sciences, graduate seminar, Juneau, 16Sep05.

Public Meeting Presentation on Open Pit Mining and Pebble Mine in Homer, AK, 17Nov05

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Presentation to The Nature Conservancy Alaska Board on the Pebble mine, Anchorage, AK, 18Nov05.

2003

Presentation to the City of Juneau Planning Commission on the Juneau Mining Ordinance, 22 Apr 03.

Presentation to the Non-Ferrous Metals Sustainable Development Production Working Group Meeting, Toronto, ON, 11 Mar 2002.

Panel Presentation to the Global Mining Initiative “Resourcing the Future” Conference Sub-Plenary Session on “Large Volume Wastes,” Toronto, ON, 14 May 02.

Presentation to a general meeting of the Tr’ondëk Hwech’in First Nation on the potential cyanide and water quality impacts from the Brewery Creek Mine, in Dawson City, Yukon, 4 Jun 02.

2002

Resources For the Future Panel Presentation on “The Long-Run Availability of Minerals,” Washington, DC, April 23, 2001.

Hardrock Mine Reclamation and Bonding Workshop, JR Kuipers and DM Chambers, Center for Science in Public Participation, for Alaska public interest organizations; attended by Alaska state and federal regulators, industry representatives and public interest groups; Juneau, 10 Jul 01, and Fairbanks, 12 Jul 01.

Presentation to the United Nations Environmental Program / International Council on Metals and the Environment Cyanide Management Code Steering Committee, Vancouver, BC, July 23, 2001.

Panel Presentation to the Montana Center for International Visitors Environmental Forum, Bozeman, MT, August 15, 2001.

2000

Panelist for an Issues Forum on “Toward the Zero-Discharge Mine,” Mining Millennium 2000, Toronto, Ontario, March, 2000.

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

TESTIMONY

2017

Testimony before the Montana House Natural Resources in support of Montana House Bill 593, 20Mar17.

Testimony in support of Alaska House Joint Resolution 9 before the Alaska House Fisheries Committee by phone, 6Apr17.

2013

Testimony before the Maine Joint House/Senate Standing Committees, Environment and Natural Resources on the Environmental Impact of Hardrock Mining, Augusta, ME, 24Apr13

2012

Testimony before the Alaska Senate Judiciary Committee, in Juneau, on the viability of restoring the geology/hydrology of groundwater flow during reclamation for the proposed Chuitna Coal mine, 2Mar12

2008

Testimony before a Joint Panel of the Minnesota Legislature (the House Environment and Natural Resources Finance Division; the House Higher Education and Work Force Development Policy and Finance Division; the Senate Environment, Energy and Natural Resources Budget Division; and the Senate Economic Development Budget Division) on sulfide mining, in St. Paul, MN, 25Jan08

Provide technical comment to HB134 on the definition of a “sulfide ore body” before the Alaska House Special Committee on Fisheries, by teleconference, Monday, February 18, 2008

EXPERT WITNESS

2012

Expert witness in Wisconsin Resources Protection Council, Center for Biological Diversity, and Laura Gauger, Plaintiffs, v. Flambeau Mining Company, Defendant, Case No. 11-cv-45, in the United States District Court for the Western District of Wisconsin, Madison, WI, 20Mar12

Expert Witness Testimony, before the Water Quality Appeals Board, Department of Administration, State of Arizona, Gregory C. and Carol A. Shinsky, Appellants, versus the Department of Environmental Quality, Phoenix, AZ, 20Sep12

2011

Expert Report on Water Quality Violations at the Flambeau Mine, 10Oct11;

Expert Report on Potential Mitigation Measures for the Water Discharge at the Flambeau Mine, 24Feb12; and Deposition in Madison, WI, 20Mar12.

2010

PUBLICATIONS, PRESENTATIONS, PROFESSIONAL REPORTS, TESTIMONY

DAVID M. CHAMBERS, Ph.D., P. Geop.

Testimony in The Superior Court for the State of Alaska, Third Judicial District, at Anchorage, Nunamta Aulukestai, et al., Plaintiffs, vs. State of Alaska, Department of Natural Resources, Defendant, and Pebble Limited Partnership, Intervenor-Defendant, Case No.: 3 AN-09-09173 CI, December 8-9, 2010

2003

Testimony to the Yukon Water Board on the applicability of a requested change for selenium in the Water License for the Brewery Creek Mine, in Whitehorse, Yukon, 24 Nov 03.

APPENDIX 2

ASSESSMENT BY KENDRA ZAMZOW, PH.D.

RELIABILITY OF WATER QUALITY PREDICTIONS AT THE KSM MINE
RELEVANT TO AQUATIC LIFE IN THE UNUK RIVER (MAR. 21, 2018)

CENTER for SCIENCE in PUBLIC PARTICIPATION

PO Box 1250 Chickaloon, AK 99674
Phone (907) 354-3886 / web: www.csp2.org / e-mail: kzamzow@csp2.org
“Technical Support for Grassroots Public Interest Groups”



March 21, 2018

Kenta Tsuda
Earthjustice
325 Fourth Street
Juneau, AK 99801
E: ktsuda@earthjustice.org

Re: Reliability of water quality predictions at the KSM mine relevant to aquatic life in the Unuk River

Dear Kenta:

The following memo responds to your request for my opinion about the reliability of surface water quality predictions in the environmental impact statement (EIS) for the Seabridge Gold Inc. (Seabridge) Kerr-Sulphurets-Mitchell (KSM) Mine.¹ Seabridge has conducted baseline surface water quality sampling, and also generated predictions for metal concentrations in the Sulphurets and Unuk River watersheds once the mine’s water treatment plant is operating.

The EIS describes current drainage from natural acid generating rock in the glacial valley of Upper Mitchell Creek. This drainage contributes metals to Sulphurets Creek, and from there to the Unuk River system; in particular cadmium, copper, and zinc concentrations are elevated in this manner.² Surface waters in the Unuk River at the Canada-United States border (“Site UR2”) currently fail to meet Alaska water quality criteria (WQC) for aluminum, iron, cadmium, copper, and lead. As part of its mine plan, Seabridge intends to capture the waters of Upper Mitchell Creek, combine them with mine wastewater, and treat this combined feed water, before releasing effluent to the Sulphurets Creek watershed. Seabridge has generated water quality predictions for surface waters within Sulphurets Creek as well as for two points along the Unuk River downstream of the confluence with Sulphurets Creek. Seabridge predicts that, by treating the waters of Upper Mitchell Creek, its treatment plant would reduce concentrations of several metals, such that with the exception of selenium pollution (which Seabridge concedes would increase), water quality in the Unuk River would be improved.

The letter submitted by you, among others, to Secretary of Commerce Wilbur Ross under the Pelly Amendment to the Fishermen’s Protective Act (“the B.C. Mines Pelly Petition”) dated September 26, 2017, refers to Seabridge’s predictions. You asked for my opinion regarding the

¹ Seabridge Gold, Application for an Environmental Assessment Certificate / Environmental Impact Statement: KSM Project (July 2013).

² As average and/or 85th percentile, the following analytes are around ten times higher at the Unuk River downstream of the confluence with Sulphurets (“Site UR1”) than in the Upper Unuk River above the confluence (“Site UR1A”): cadmium, copper, zinc. The following are around two times higher: sulfate, aluminum, arsenic, cobalt, iron, lead, manganese, silver, gold, uranium. Slight increases are observed for: barium, calcium, molybdenum, potassium, selenium, silicon and vanadium. Additionally, there is a slight decrease in pH and alkalinity and slight increase in conductivity and hardness.

reliability of these predictions. In my opinion, Seabridge's predictions are misleading, may be overly optimistic, and do not sufficiently address risks to aquatic life, particularly at the point where the waters enter the United States.

Seabridge's predictions are misleading. Seabridge generalizes from predicted changes in total levels of metals, but the absence of corresponding predictions for the dissolved forms of these metals is a critical weakness: it is the dissolved form of metals that is most toxic to aquatic life. Seabridge made predictions for dissolved concentrations of only two metals: aluminum and iron. With respect to these, not only did levels of the total and dissolved forms of the metals change at different rates, but also dissolved concentrations were predicted to *increase* in the Unuk River while total metals concentrations decreased relative to the baseline. The omission of predicted dissolved metals levels for all other metals renders Seabridge's predictions misleading.

Reliance on Seabridge's predictions may be overly optimistic. I considered Seabridge's prediction using a mass balance comparison of baseline and predicted scenarios. This comparison indicated that with respect to metals³ that could be harmful to aquatic life—selenium, cadmium, and copper—Seabridge assumes that rates of precipitation will be higher in the predicted scenario than were observed in the same segments of river in the baseline. This disparity is unexplained, and leads me further to question the reliability of Seabridge's predictions.

Seabridge used a water quality model to predict concentrations and behaviors of metals. Its predictions are only as reliable as the inputs to the model. My analysis raises some questions about whether the model's simulated feed waters accurately represent what would be used at the actual treatment site; inaccuracies could lead to understatement of risks. Additionally, Seabridge's model is missing critical baseline data. In the absence of this data, it is not possible to tell whether Seabridge's predictions include rates of precipitation similar to those observed in baseline studies or, alternatively, whether Seabridge is generating inexplicably different patterns for prediction purposes. Without this information, it is not possible to have confidence in Seabridge's predictions. Lastly, Seabridge's predictions are premised on the assumption that the treatment plant and mine infrastructure will work flawlessly for decades, an assumption that I question.

In sum, the picture that Seabridge paints of the KSM Mine's impacts on the downstream environment is not sufficient to understand potential harms. How and to what degree metal concentrations in the Unuk River system would change once the KSM Mine is operational cannot be answered on the basis of the information Seabridge has presented. Interested parties should take the risk of water quality harms seriously in this context.

³ Both metals and metalloids are referred to collectively as "metals" in this letter for simplicity.

I. OMITTED PREDICTIONS OF DISSOLVED METALS

Seabridge does not predict levels of dissolved metals; it only predicts total-metals concentrations. Dissolved metals are a subset of total metals. The dissolved form of metals is the more bioavailable form, and therefore is more relevant for evaluating risks to aquatic life. Although Seabridge states that for purposes of prediction dissolved and total metals levels are assumed to be identical,⁴ which might seem like a conservative assumption.

It is in fact not a conservative assumption; in fact, the resulting analysis might understate the magnitude of impacts from dissolved metals. The dissolved form of a metal is more bioavailable for fish, therefore, to evaluate potential impacts to fish, it is more important to consider the dissolved concentration of a metal than its total level. There is no reason to believe that treatment of mine effluent will reduce dissolved concentrations to the same degree that it reduces total concentrations. A metals total concentration may fall while the more bioavailable dissolved form declines less sharply, remains unchanged, or even increases.

Differences between rates of change in a metal's total and dissolved forms can be observed in Seabridge's predictions for aluminum and iron, the only two metals for which the company predicted both total and dissolved concentrations. What these predictions show is that rates of change (relative to the baseline) differs for total metals and dissolved metals levels. Depending on which part of the distribution one looks at—mean, median, or 85th percentile concentrations—the degree of difference changes. It is important to consider more than mean metals levels, since exposure concentrations at critical life stages for fish are important to assessing risk even if exposures are deviations from the mean, e.g. temporarily higher concentration events, captured in the 85th percentile.

Comparison of total and dissolved metals for aluminum and iron show differentials in change: with mean and median levels, reference only to total metals levels overstates the changes with respect to the more bioavailable dissolved form of the metal. For example, with aluminum, at Site UR2, in the baseline sample, the median level of total aluminum was 1,585 µg/L; in its prediction, median aluminum would fall to 592 µg/L, a 63 per cent decline.⁵ Meanwhile, median dissolved aluminum would fall from 53 µg/L in the baseline to 38 µg/L,⁶ a smaller 26 percent decline.

More importantly, reference to total metals is misleading with respect to the 85th percentile concentration. The 85th percentile of baseline water quality is what the State of Alaska looks at when evaluating water quality discharge permits, and so it is a relevant measurement to apply:

⁴ See EIS at 14-38: “Dissolved loadings from Project components were assumed to be equivalent to total loadings due to designed control of [total suspended solids or TSS] to meet federal and provincial discharge limits (e.g., 15 mg/L TSS).”

⁵ Baseline median was calculated from data in EIS Appendices 14-A and 14-B; statistics for predictions were calculated from data in Appendix 14-H11.

⁶ *Ibid.*

- 85th percentile of total aluminum changes from 4,655 µg/L in the baseline to 4,530 µg/L in the prediction—a 3 per cent decrease. However, the 85th percentile of dissolved aluminum changes from 84 µg/L to 111 µg/L—a 32 per cent increase.⁷
- 85th percentile total iron changes from 6,711 µg/L in the baseline to 5,510 µg/L in the prediction—an 18 percent decrease. However, the 85th percentile of dissolved iron changes from 51 µg/L to 96 µg/L—an 88 per cent increase.⁸

Table 1. Comparison of change in 85th percentile total metals versus dissolved metals (for years 0-25 at Site UR2)

	Baseline (µg/L)	Predicted (µg/L)	Percent change
Total Al	4,655	4,530	-3%
Dissolved Al	84	111	32% increase
Total Fe	6,711	5,510	-18%
Dissolved Fe	51	96	88% increase

Seabridge has not provided dissolved metals predictions for other metals like cadmium and copper, notwithstanding the acute risks these metals can pose to aquatic life in their dissolved forms. This omission is more than a mere data gap—Seabridge’s assumption that its predicted changes in total metals will correspond to changes in dissolved forms is contradicted by the examples of aluminum and iron. The result is that Seabridge is potentially overstating the efficacy of its treatment plan, and understating the risks that its project would pose to aquatic life downstream of the Mine.

II. PREDICTED WATER QUALITY MAY BE OVERLY OPTIMISTIC

In order to evaluate assumptions underlying Seabridge’s predictions, I attempted to compare Seabridge’s predictions with the baseline samples in terms of mass balances. “Mass balance” refers to the amount of a metal present at a location in the water column at a given time, calculated by multiplying the concentration at a given location by the flow rate. Looking at mass balances allows tracking of metals entering and exiting the water column: where mass balance increases, there is a source of metals; where it decreases, metals are precipitating out of the water column into sediment.⁹ I expected to observe similar patterns of precipitation in the baseline and predicted scenarios, with the exception of differences at Mitchell Creek due to diversion of Upper Mitchell Creek and addition of wastewater treatment plant flow. This is because

⁷ *Ibid.*

⁸ *Ibid.*

⁹ Areas of metal precipitation are of interest as these may be places where metals concentrate in sediment. Precipitation may reduce the toxicity, or it may shift the risk of toxicity to organisms in sediment, which are then consumed by fish.

environmental factors that control precipitation of metals, such as pH, alkalinity, and redox, are not expected to change in Sulphurets Creek or the Unuk River.

My analysis indicated, however, that for several metals Seabridge's predicted mass balances are notably lower than what one would expect given the baseline's levels of precipitation. In Seabridge's predictions cadmium, copper, and selenium behave differently than would have been expected from the baseline sample.¹⁰ These discrepancies indicate that Seabridge's prediction model has higher predicted rates of precipitation than were observed in the baseline. The calculations I made were based on limited information. Transparency in the Seabridge model and complete data on water quality and stream flow in the Sulphurets and Unuk River systems are needed. But if Seabridge's apparent assumptions are wrong, Seabridge's predictions are also inaccurate: if predictions are inaccurate, levels for several metals may be much closer to the baseline and, in fact, may not be much reduced in concentrations by mine waste water treatment. In my opinion, the lack of data for an accurate mass balance renders Seabridge's predictions unreliable.

To make the comparison, I converted Seabridge's *baseline* sampling data into mass values (mass is the product of concentration and flow), and used these values to derive expected mass at a specific sample site. I converted Seabridge's *predictions* into mass values using year 0-25 predicted concentrations (period of mine operation)¹¹ to derive the mean concentration for sites SC2, SC3, and UR2; for other sites (UR1A, SC1, Ted Morris Creek, and Gingras Creek), I applied baseline mean concentrations under the assumption that concentrations would not change at these locations. I also applied baseline flow for Sites UR1A, Ted Morris, and Gingras Creeks. For effluent, I applied an average effluent flow rate of 2.5 meters per second (m^3/s);¹² monthly average flows for years 0-25 are expected to range from 0.1 m^3/s to 7.3 m^3/s .¹³ Key sites on Sulphurets Creek, above and below the confluence with Mitchell Creek (SC1 and SC2, respectively) as well as the most downstream site on Mitchell Creek (MC2), have only simulated—not measured—flows. For predicted flows for sites MC2, SC1, SC2, and SC3, I used year 0-10 flows to derive average annual flow at each location (annual flows are relatively constant for the 10 year increments).¹⁴ Site UR1 had no baseline or predicted flows, so I did not calculate mass balances for this site. Seabridge did not provide measured or predicted flow for Site UR2, however, the United States Geological Survey had a stream gage on the Unuk River near the Canada-United States border (gage #15015590, also called Canadian WSC gage

¹⁰ Lead (Pb) may also be an issue. The EIS states the treated effluent will have a total lead concentration of 56 $\mu g/L$, which is quite a high concentration. See EIS at 14-118, Table 14.7-23 & EIS Appendix 14-F at 7-27, Table 7.2-1 listing water treatment plant feed water at 37 $\mu g/L$ (dissolved lead), effluent at 0.67 $\mu g/L$ (dissolved lead), with 98% removal efficiency for dissolved lead, but with effluent containing 56 $\mu g/L$ of total lead. It may be that this table includes a misplaced decimal point; alternatively, more information should be disclosed regarding the treatment of total lead.

¹¹ EIS Appendix 14-H.

¹² EIS at 14-116.

¹³ EIS Appendix 14-I.

¹⁴ EIS at 13-60, Table 13.7-3.

08DD001) that collected discharge flow data 1960-1996 near Site UR2. My calculations can be followed in spreadsheets that are available upon request.

The results of my comparisons are as follows:

Selenium

In the baseline sample, the mean total selenium mass in Upper Mitchell Creek was 1.5 kilograms per day (kg/d) and was 1.6 kg/d in Lower Mitchell Creek—indicating no net precipitation of selenium in this stretch of the Creek. Similarly, the total selenium mass for the combined sites¹⁵ that contribute to Site SC2 contribute 2.6 kg/d and Site SC3 (Sulphurets Creek just before it enters the Unuk River) adds 2.9 kg/d, indicating virtually no precipitation or new sources.

In Seabridge's predictions, the wastewater treatment plant would release a mean total selenium mass of 15 kg/d and the mass at Lower Sulphurets Creek would be 6 kg/d—this decline in mass either indicates substantial precipitation in Mitchell Creek or Sulphurets Creek.

These changes in mass balance indicate that Seabridge posits higher rates of precipitation in the predicted scenario than would be expected from the baseline. The departure from observed precipitation in the baseline sample is unexplained. The predictions may underestimate the impacts of selenium from the mine.

Cadmium

In the baseline sample, cadmium experienced only slight net precipitation in Sulphurets Creek: combined inputs to Site SC2 were 2.8 kg/d and the mass at Site SC3 is calculated to be 3.2 kg/d, *a slight (14 percent) increase*. The baseline sample indicated precipitation of cadmium in the Unuk River —*a 27 percent net precipitation*.¹⁶

In Seabridge's predictions, half of the total cadmium at Site SC2 (1.4 kg/d) precipitates along Sulphurets Creek (0.7 kg/d at SC3)—*a 50 percent net precipitation*. Holding contributions of unaffected waterbodies constant (the upper segment of the Unuk River and other tributaries to the River) for a combined mass of 1.05 kg/d precipitates to 0.5 kg/d at Site UR2—*a 52 percent net precipitation*.

These changes in mass balance indicate that Seabridge posits higher rates of precipitation in the predicted scenario than would be expected from the baseline. The departure from

¹⁵ These are Sulphurets Creek above the confluence with Mitchell Creek (SC1) plus the Ted Morris tributary to Sulphurets Creek (SCT), plus Lower Mitchell Creek (MC2), plus Gingras Creek tributary to Sulphurets Creek (GC1).

¹⁶ Combined sources of Upper Unuk River (UR1A) + Sulphurets Creek (SC3) + the tributary South Unuk River (SUNR) = $0.1 + 3.1 + 0.1 \text{ kg/d} = 3.3 \text{ kg/d}$ should reach Site UR2. However, mass balance at Site UR2 is calculated to be 2.5 kg/d, indicating precipitation along the Unuk River.

observed precipitation in the baseline sample is unexplained. The predictions may underestimate the impacts of cadmium from the mine.

Copper

In the baseline sample, mean total copper mass experienced about a 50 percent precipitation rate in Mitchell Creek. A smaller rate of precipitation occurs along Sulphurets Creek, with 304 kg/d at Site SC2 falling to 272 kg/d at Site SC3—a 10 percent net precipitation.¹⁷ Within the Unuk River, Sulphurets Creek contribute 272 kg/d, the upper segment of the Unuk River would contribute a load of 10 kg/d, and other tributaries to the Unuk River would contribute 12 kg/d, for a load of approximately 294 kg/d that precipitates to a mass of 273 kg/d at Site UR2—a 7 percent net precipitation.

In Seabridge's predictions, the copper mass contributed by sources upstream of Mitchell Creek seem to have been excluded, presumably diverted to the wastewater storage pond. The combined mass from upstream Sulphurets Creek sources, Lower Mitchell Creek, and treated effluent is 103 kg/d at the confluence of Mitchell and Sulphurets Creek, falling to 65 kg/d at Site SC3—a 46 percent net precipitation. Within the Unuk River, the mass contributed by Sulphurets Creek, combined with mass contributed by other tributaries to the Unuk River would total 87 kg/d, which Seabridge predicts precipitating to 28 k/d at Site UR2—a 67 percent net precipitation.

These changes in mass balance indicate that Seabridge posits higher rates of precipitation in the predicted scenario than would be expected from the baseline. The departure from observed precipitation in the baseline sample is unexplained. The predictions may underestimate the impacts of copper from the mine.

III. ASSUMPTIONS UNDERLYING WATER QUALITY PREDICTIONS MAY BE OVERLY OPTIMISTIC

Seabridge's predictions include several questionable assumptions, with the result that the EIS likely presents an overly optimistic account of the proposed treatment system's ability to reduce metals concentrations.

Reliance on Pilot Plant Demonstration

The first assumption that underlies Seabridge's predictions is that its pilot plant treatment demonstration is an accurate and reliable basis for water quality predictions. To account for mine effluent's contributions to downstream waters, Seabridge estimated effluent concentrations.¹⁸ It did this by running a pilot plant to demonstrate the capacity of its high density sludge process to remove metals from feed water. However, to account for captured

¹⁷ It is noteworthy that in the baseline, while total copper precipitates, dissolved copper levels increase, from 14 kg/d at Site SC2 to 18 kg/d at SC3.

¹⁸ EIS at 14-118, Table 14.7-23.

Mitchell Creek waters, the pilot plant demonstration uses inputs that average concentrations from all Mitchell Creek stations—rather than using concentrations from Upper Mitchell Creek, where the water would be actually captured and routed to the water treatment plant.¹⁹ The Upper Mitchell Creek station has much higher concentrations of metals than Lower Mitchell Creek—as noted above, nearly all copper and about half the cadmium of Upper Mitchell (MC1A) precipitates out before it reaches Lower Mitchell Creek (MC2).²⁰ The “Mitchell Creek” component of the simulated feed water should have represented the much higher concentrations of metals; by using the average across all Mitchell Creek, the pilot plant was processing feed water with unrealistically low metal concentrations. Pilot plant testing with a more accurate representation of feed water will provide better information on how well the intended equipment will remove metals. If metal concentrations in effluent are higher with more concentrated feed water, Seabridge’s predictions downstream may be too low. The higher metal concentration that is likely to be in simulated feed water will also produce a more voluminous waste sludge. This requires a larger area for disposal. This needs to be accounted for in mine design and costs. If Seabridge requires better or more equipment or reagents to achieve the anticipated concentrations of metals in water treatment plant effluent, the operation will be more expensive. For economic and environmental analysis, the pilot plant testing needs to be re-run with more realistic simulated feed water.

It is usual for mine companies to build a margin of error into predictions based on laboratory demonstrations of treatment. It seems that Seabridge built in a margin of error here, but it is not possible to characterize this as conservative: the predictions are conservative relative to the pilot plant demonstration, but the fidelity of the pilot plant feed water to reality, and therefore the predictions’ overall conservativeness, may be flawed.

Seepage

Seabridge also assumes that there will be seepage at a rate of one liter per second from waste rock. It assumes no seepage from its underground chambers and tunnels. Without more information, one cannot know if this assumption is reliable. Tunnels will have to be dewatered, and there may be reason to expect that they will experience water seepage containing metals. This would depend on the quality of the rock through which tunnels are bored, fractures and fault lines, and groundwater aquifers. It will also depend on the orientation of the tunnels, their elevation, and location. It is possible that Seabridge’s one liter per second assumption is overly optimistic. If so, it will affect both feed water to the wastewater treatment plant, which could affect plant efficacy and cost, and potential sludge volume.

¹⁹ EIS Appendix 4-T and EIS at 14-118, Table 14.7-23, state expected metal concentrations in water treatment plant feed water and effluent; baseline water quality for Mitchell Creek stations is in EIS Appendices 14-A and 14-B.

²⁰ See discussion above at 6-7.

Efficacy of Treatment System and Mine Infrastructure

Seabridge's predictions about water quality and residual effects are premised on the efficacy of its mine infrastructure, including its water treatment facility. Implicit in use of these predictions is the assumption that the treatment plant and containment infrastructure will work seamlessly over their operating lives. Seabridge's treatment plant will operate not only over the life of the mine—52 years—but also for a period after mine closure “until discharge quality meets targets”—projected to be 250 years.²¹ When operating it will treat up to 118,887 gallons of water per minute. Feed waters—even if the model is accurate—will contain extremely concentrated metals.²²

But it is highly likely that during the mine's operating life, mistakes and unforeseen shortcomings will result. No large industrial operations, whether in the mining sector or not, operate flawlessly. The question is the degree of the problems that arise and the ability to respond quickly and effectively. Some modern mines offer examples of serious problems: At the Rock Creek Mine in Nome, Alaska, predictions for water balance (the source and amount of water to be handled) were inaccurate, forcing the mine to shut down two months into operation;²³ at the Mount Polley Mine in British Columbia, a serious tailings dam failure destroyed a creek and allowed metal-rich tailings to settle in an important salmon spawning lake;²⁴ at the Buckhorn underground mine in Washington state, operators were unable to control contaminated groundwater, which is reaching surface waters.²⁵ There can be an alternative path, of caution, and examples exist in which regulators take concerns seriously and change the trajectory of permitting: At the proposed Carmacks Copper Heap Leach, an untested method for rinsing the heap at closure caused the Yukon Water Board to deny a permit;²⁶ in British Columbia, the proposed Ajax Mine was not issued an environmental assessment certificate.²⁷ Mistakes or system failures frequently reduce water quality, including through the increase of

²¹ B.C. Mines Pelly Petition at 19.

²² EIS at 4-118, Table 14.7-23.

²³ David Chambers, *Rock Creek Mine Problems* (2012).

²⁴ See generally Independent Expert Engineering Investigation and Review Panel, *Report on Mount Polley Tailings Storage Facility Breach Independent* (Jan. 30, 2015), <https://www.mountpolleyreviewpanel.ca/sites/default/files/report/ReportonMountPolleyTailingsStorageFacilityBreach.pdf>; Quesnel River Research Centre, *QRRC Research Relating to the Mount Polley Mine Tailings Pond Breach* (last visited Feb. 16, 2018), <https://www.unbc.ca/quesnel-river-research-centre/mount-polley>; E. L. Pettigrew et al., *The impact of a catastrophic mine tailings impoundment spill into one of North America's largest fjord lakes: Quesnel Lake, British Columbia*, 42 Geophys. Res. Lett. 3347 (2015), <https://www.unbc.ca/sites/default/files/sections/quesnel-river-research-centre/petticrewetal.2015grlcorrectedversion.pdf>.

²⁵ Stratus Consulting Inc., *Analysis of Water Quality Impacts at the Buckhorn Mountain Mine and Recommendations for Improvement* (Nov. 4, 2010), <https://docs.google.com/a/okanoganhighlands.org/viewer?a=v&pid=sites&srcid=b2thbm9nYW5oaWdobGFuZHMub3JnfG9oYXxneDozZjU3NDcyODc5ZDAxYWI1>.

²⁶ C. Oke, *Water board rejects Carmacks Copper proposal*, Yukon News (May 12, 2010), <https://www.yukon-news.com/news/water-board-rejects-carmacks-copper-proposal/>.

²⁷ British Columbia, *Ajax open-pit copper and gold mine not granted an environmental assessment certificate*, BC Gov News (Dec. 14, 2017), <https://news.gov.bc.ca/releases/2017ENV0072-002055>.

metals concentrations. The assumption of seamless perfection in the operation of relevant mine infrastructure is an unsound and dangerous assumption.

IV. CONCLUSION

On its face, the KSM Mine's EIS describes that, notwithstanding excavation of one of the world's largest copper-gold deposits, the mine would remediate naturally elevated average metal levels in downstream waters. However, Seabridge openly predicts the mine would increase average selenium levels in downstream waters, and my analysis indicates that dissolved metals will increase above baseline at the Unuk River. Predictions for additional metals beyond aluminum and iron must be provided.

Seabridge's predictions also leave several critical points of basic information unstated, and involve expectations that metals will behave in manners contrary to baseline observations. The net effect may be to understate metals levels. The KSM Project's EIS thus leaves substantial questions about the reliability of its predictions, and reason to believe that the mine could be significantly detrimental to the downstream environment. There is ample evidence of mines where predictions related to water quality and/or hydrology were insufficient (e.g., Rock Creek mine and Red Dog mine in Alaska; Buckhorn mine in Washington State). There are also examples of spectacular failures due to lack of information, adequate mitigation, and backup systems (e.g., Mount Polley Mine in British Columbia).

Parties interested in the quality of downstream surface waters, and the resources dependent upon these waters, not least officials the Department of Commerce investigating the mine pursuant to the B.C. Mines Pelly Petition, should be seriously concerned about the impacts from the KSM Mine. The figures provided by Seabridge in the KSM Mine's EIS likely understate metals levels that will be experienced in downstream water—there is insufficient information to have a clear idea of what the margin of understatement is.

Sincerely,



Kendra Zamzow
Kendra Zamzow, PhD

Kendra Zamzow

PO Box 1250, Chickaloon, AK 99674
Phone: (907) 354-3886 / e-mail: kzamzow@csp2.org

Statement of Qualifications

Dr. Zamzow is an environmental biogeochemist and the Alaska representative for the Center for Science in Public Participation (CSP2). She specializes in environmental chemistry, microbiology, and environmental toxicology, particularly related to mining projects, and has provided technical analysis of mining projects on behalf of communities and tribe, including comments on regulatory issues and expert witness testimony, since 2008. She has been an Associate Editor for the peer reviewed journal "Mine Water and the Environment" since 2013.

In 2012 she accepted a competitive Science & Technology Policy Fellowship through the American Association for the Advancement of Sciences and spent 16 months in the Washington, DC offices of the EPA's Office of Research and Development/Office of Science Policy with the team developing the "Hydraulic Fracturing and Drinking Water" report.

Education

Ph.D. Environmental Sciences and Health	University of Nevada, Reno	2007
B.A. Cellular and Molecular Biology	Humboldt State University, California	1986

Professional courses and mining conferences

2017	Geochemical modeling short course	Lappeenranta, Finland
2017	International Mine Water Association (presenter)	Lappeenranta, Finland
2014	Arsenic geochemistry short course	Nevada City, CA
2011	Global mine water initiative	Las Vegas, NV
2011	Northern Latitudes mine reclamation workshop	Fairbanks, AK
2010	Impacts of metals and metallic mining on aquatic ecosystems	Anchorage, AK
2010	Geoenvironmental modeling of ore deposits	University of Ottawa
2008	Mine Design, Operations, and Closure conference	Butte, MT
2007	International Mine Water Association (presenter)	Sardinia, Italy

Multi-agency working groups

2015-2018	Human Health Water Quality Criteria working group <i>recommendations on more stringent statewide water quality regulations</i>	Anchorage, AK
2011-2013	Humbug Creek Watershed Assessment, convened by CA State Parks <i>site characterization and reclamation options for hydraulic mining-damaged areas</i>	Grass Valley, CA
2010	Mercury working group, convened by Region X EPA <i>develop statewide contaminants monitoring framework</i>	Anchorage, AK

Testimony

2017	Viability of the proposed Arctic deposit	hearing, House Resources Committee, Juneau AK
2017	Expert witness testimony, Back 40 prospect	hearing, Michigan State admin. judge, Lansing, MI
2010	Fish habitat protections, Pebble prospect	hearing, Alaska Board of Fisheries
2009	Expert witness testimony on Pebble prospect	constitutional lawsuit, Alaska Supreme Court
2009	Technical concerns on the Pebble prospect	hearing, Senate Resources Committee, Juneau AK

Kendra L. Zamzow, Ph.D.

Employment History

Dr. Zamzow has been employed as a staff scientist with the Center for Science in Public Participation (CSP2) since 2008. She took a 16-month leave (Sept 2012 – Dec 2013) for a Science & Technology Policy Fellowship through the American Association for the Advancement of Sciences (AAAS) in Washington, D.C.

• Staff scientist, Center for Science in Public Participation; Chickaloon, AK	2008-current
• Science & Technology Policy Fellow, AAAS; Washington DC	2012 - 2013
• Research assistant, University of Nevada Reno; Reno, NV	2003-2007
• Staff scientist, Alaska Community Action on Toxics; Anchorage, AK	2001-2002
• Laboratory technician, Prince William Sound Science Center; Cordova, AK	2000-2001
• Adjunct instructor, Prince William Sound Community College; Cordova, AK	1998-2000
• Commercial fisherman, Cordova, AK	1991-1997
• NMFS and State of Alaska Fisheries Observer; Anchorage and remote, AK	1989-1993

Relevant Professional Experience

Dr. Zamzow has provided technical analysis of projects including copper heap leach closure, arsenic chemistry in tailings, mercury release from thermal processing of gold, potential for acid drainage, and chemistry of underground coal gasification. She has commented on regulatory issues including federal gold mine mercury air emission regulations and Alaska coal and water quality regulations. Dr. Zamzow has provided testimony to Alaska state legislative bodies, provided expert witness testimony before the State of Alaska and State of Michigan, and designed and implemented water-sampling programs in a remote wilderness area.

Hard rock mining – Pebble mine

The Nature Conservancy, Pebble mine, Alaska. Designed, in coordination with benthic invertebrate and fish survey teams, a water-quality sampling plan that spanned several watersheds. Reviewed and synthesized laboratory results, assessed quality control/quality assurance, and prepared final report. Information has been presented at professional conferences (see “Selected Presentations” list). Final report sent to the EPA to support an EPA assessment of risks in the Bristol Bay watersheds. 2008-2011.

- Zamzow, KL. 2011. Investigations of surface water quality in the Nushagak, Kvichak, and Chulitna Watersheds, Southwest Alaska, 2009-2010. 52p. Nature Conservancy, Anchorage, AK.
- Zamzow, KL. 2011. Critique of PLP water quality data for the Pebble prospect, Alaska. 236p.

Nunamta Aulukestaii, Pebble mine, Alaska. Provided technical support and traveled to several villages and towns to present information regarding the technical risks related to the Pebble mine in public forums. (See “Selected Presentations” list). 2009.

- Zamzow, KL. 2010. Potential impacts to water during exploration at the Pebble prospect, Alaska. 76p.

Nondalton Tribal Council, Pebble mine, Alaska. Analysis of regional water quality and potential threats to water quality as part of the Nondalton Integrated Resource Management Plan. 2014.

- Zamzow, KL. 2014. Nondalton Integrated Resource Management Plan, Water Quality chapter, 63p.

United Tribes of Bristol Bay, Pebble mine, Alaska. Developed and conducted field sampling plan to document contamination from exploratory drilling and document failure of reclamation. Analyzed lab data, produced a

Kendra L. Zamzow, Ph.D.

report that resulted in Alaska DNR determining that PLP should put up a reclamation bond and applied other requirements attached to the land use permit. 2016-2017.

- Zamzow, KL and D Chambers. 2016. Investigation of reclaimed drill sites, Pebble prospect, 2016. 74p. United Tribes of Bristol Bay, Dillingham, AK.

CSP2 testimony. Pebble mine.

- Expert witness testimony regarding risks to water from drilling at the Pebble mine site (*Nunamta Aulukestaii et al v State of Alaska*) for the plaintiffs (Nunamta Aulukestaii) challenging exploration permit (2009).
- Invited testimony regarding technical risks and risks to water quality to the Alaska Senate Natural Resources Committee (2009).
- Invited testimony to the Alaska Board of Fisheries in support of legislation to expand fisheries habitat protections in the Nushagak and Kvichak drainages (2010).

Hard rock mining – other Alaska and Canadian mines

Brooks Range Council and Wilderness Society, Ambler mining district, Alaska. Reviewed the economic viability of ore bodies and environmental risks based on available geochemistry. Developed information sheets for villages on how to comment on an EIS. Provided invited testimony to state legislative committee. 2016-2018.

- Ambler road and mining district information brief, 17p.
- Invited testimony to Alaska House Resources Committee Oversight Hearing regarding economic viability of the Arctic and associated deposits (2018).

Earthjustice, KSM copper mine, British Columbia. Review of baseline and predicted water quality in mine drainage of a proposed large scale copper mine, with a focus on potential changes to water quality where the receiving river crossed from Canada into Alaska. In support of a petition to the US Dept of Commerce. 2017 – 2018.

- Influences on water quality to the Unuk River at the Alaska-BC border, 36p, provided as an attachment to a Supplemental letter to the US Department of Commerce, regarding BC Mines Petition under the Pelly Amendment (2018)

Takshanuk Watershed Council, Haines Alaska. 2018. Review of proposed Constantine mine and panelist in Mining Forum.

- Exploration and mining impacts and mitigation, 40p powerpoint (2018)

Chuathbaluk Tribe, Donlin gold mine, Alaska. Provided technical support for the Native Village of Chuathbaluk in their role as a cooperating agency in the development of the EIS for the Donlin mine. Reviewed early drafts of EIS chapter material and hundreds of supporting documents and memos, with a focus on data gaps in baseline sampling and impacts to smelt, mine waste management, water treatment, failure modes analysis, pit lake evolution, invasive species, climate change, reclamation and closure plans, human health risk analysis, ecotoxicity risk analysis, and mitigation throughout the process of developing the draft and final EIS material. At the request of the Donlin environmental manager, reviewed the mining company's Mercury Management Plan. Primary contaminants of concern are mercury, arsenic, and selenium. Reviewed the state-issued wastewater discharge

Kendra L. Zamzow, Ph.D.

permit and mine waste permit. Explained components of the project to the tribe in layman's terms through memos, phone calls, and in person visits to the village. 2013-2018.

- Multiple memos and letters
- Comments to Army Corps of Engineers on Donlin draft EIS, 47p (2016)
- Comments to Alaska DEC on draft wastewater discharge permit, 7p (2018)
- Comments to Alaska DEC on draft integrated waste management permit, 17p (2018)

Tr'ondek Hwech'in First Nation, Coffee Creek gold heap leach, Yukon. Attended meetings with Tr'ondek Hwech'in, Kaminak Mining, and Kaminak consultants regarding baseline work and the proposed mine. Reviewed feasibility study, baseline studies, and technical reports. Provided a 3-day training to First Nation members on how to review an Environmental Assessment. 2016.

- Chambers, D and K Zamzow. 2016. Comments on waste rock storage facility stability, 5p.

Tr'ondek Hwech'in First Nation, Casino gold heap leach, Yukon. Reviewed mine proposal and Yukon Environmental and Socio-economic Assessment Board (YESAB) adequacy review in the areas of water quality, water treatment and discharge, aquatic baseline, heap leach closure, air quality, emergency response and climate change. 2015-2016.

- Chambers, D, K Zamzow, S Levit. 2015. Comments on Casino Mine proposal YESAB Adequacy Review, 13p
- Chambers, D, K Zamzow, CA Woody, S Levit, SL Carroll. 2015. Comments on CMC preliminary response to YESAB Adequacy Review, 20p
- Chambers, D, K Zamzow, CA Woody, S Levit. 2015. Continuing concerns with Casino mine, 9p.s

Little Salmon Carmacks First Nation, Mt. Nansen gold mine, Yukon. Site visit and evaluation of approaches to remediation of a closed gold mine. The primary contaminant of concern is arsenic, with some concern over cadmium, iron, and zinc release. The goal was to have a multiple accounts assessment. 2010-2011.

- Zamzow, KL. 2011. Review of Lorax Geochemical Assessment of Mt. Nansen for Closure Options, 24p.
- Zamzow, KL 2010. Review of Mt. Nansen tailings closure geochemistry, 12p.

Donlin Creek Working Group, Donlin gold mine, Alaska. Traveled to villages to provide background information on gold processing, geochemistry, and waste disposal related to the proposed Donlin gold mine. Produced informational fact sheets after input from in-region residents. 2008-2012.

Glacier Gulch Water Group, Mt. Davidson molybdenum mine, Yukon. Reviewed Environmental Assessment on mine design, water balance, baseline studies, geochemistry, water quality predictions, and water treatment. 2008.

- Chambers, DM and K Zamzow. 2011. Comments on Davidson molybdenum mine project DEIS, 34p

Nak'azdlii First Nation, Mt. Milligan copper-gold mine, Yukon. Reviewed Environmental Assessment sections on geochemistry, mitigation through the use of wetlands, and monitoring. 2008.

Little Salmon Carmacks First Nation, Carmacks, Yukon Territory. Western Copper heap leach. Evaluation of closure options for a proposed copper heap leach project. Assessed long term geochemistry, hydrology, and copper

Kendra L. Zamzow, Ph.D.

loading. Selenium, molybdenum, and cadmium were also issues of potential concern. The result was that the Yukon Water Board denied the water use license for the operation. 2008.

- Zamzow, KL and Miller, GC. 2008. Review of Carmacks Copper heap leach closure plan, 11p.

Hard rock mining – continental US mines

Menominee Tribe of Wisconsin, Back 40 polymetallic mine, Michigan. Reviewed Environmental Impact Assessment and Mining Permit (not finalized) for geochemistry, contaminant transport, mine waste closure, water treatment and discharge, and monitoring. Provided expert witness testimony on a challenge to the Mining Permit in Michigan state administrative office. 2017.

- Zamzow, K. 2017. Memorandum on AMD risk at Aquila Back Forty, 23p.

Save the Wild U.P., Back 40 polymetallic mine, Michigan. Reviewed wetlands permit (final), mining permit (not finalized), and wastewater discharge permit (final) for wetland impacts, mine design, mine closure and reclamation, aquatic impacts, baseline water quality, and alternatives. 2017-2018.

- Zamzow, K. 2018. Review of wetland permit, 18p

Earthworks, Rock Creek mine, Montana. Review of supplemental Draft EIS on topics of geochemistry and representativeness of samples for geochemical testing. 2016.

- Zamzow, K and D Chambers. 2016. Review of Rock Creek mine draft Supplemental EIS, 19p.

Greater Yellowstone Coalition, Rasumssen Valley phosphate mine, Idaho. Reviewed EIS regarding closure cover. 2015.

- Chambers, D and K Zamzow. 2015. Comments on Rasumussen Valley draft EIS, 17p.

Earthworks, Black Butte copper-cobalt mine, Montana. Review of mining operation application on the topics of geochemistry and geochemical testing, baseline water quality, and water treatment. 2014-2017.

- Zamzow, K. 2016. Comments on Black Butte mining operation application, 6p.

Mountain Empire Action Alliance, Rosemont copper mine, Arizona. Review of EIS in the areas of geochemistry, water quality, air quality, mine waste facilities (tailings, waste rock, pit lake), water treatment, reclamation and closure, climate, alternatives, and mitigation measures. Result was denial of permit. 2012.

- Chambers, D, K Zamzow, S Levit, C Monohan. 2012. Comments on Rosemont Copper Project draft EIS, 33p

Wisconsin Resources Protection Council, Flambeau mine, Wisconsin. Reviewed water quality, sediment, and biota sampling plans and data and participated in discussions with local citizens. 2008-2009.

- Chambers, DC and Zamzow, KL. 2009. Report on groundwater and surface water contamination at the Flambeau mine. Wisconsin Resource Protection Council.

Greater Yellowstone Coalition, New World mine, Montana. Review of alternatives for wastewater treatment with a focus on bioremediation options.

- Zamzow, K. 2008. Comments on New World draft adit discharge EE/CA, 2p.

Kendra L. Zamzow, Ph.D.

University of Nevada Reno, Leviathan mine, California. Graduate research work (2003-2007) included operating a field bioreactor at the closed Leviathan copper-sulfate mine. Contaminants included acid drainage, copper, iron, aluminum, zinc, nickel, and sulfate. Collected and analyzed mine-water and reactor effluent for metals, alcohols, and metabolic acids. Identified bacteria in reactors using PCR amplification with cloning and sequencing, fluorescent in-situ hybridization, DNA staining, and terminal restriction fragment length polymorphism. Maintained laboratory columns for sulfate-reducing bacterial research studies. Operated and maintained lab equipment (GC-FID, HPLC, flame AA).

- Zamzow, K, TK Tsukamoto, GC Miller. 2006. Waste from biodiesel manufacturing as an inexpensive carbon source for bioreactors treating acid mine drainage. *Mine Water and the Environment* 25: 163-170

Coal mining - Alaska

Trustees for Alaska, Chuitna mine, Alaska. Made site visits and evaluated site data associated with permitting a 5,000 acre coal strip mine. Participated in meetings with regulators and citizens. 2007-2010.

- Zamzow, KL. 2011. Comments to Alaska DNR in support of the Chuitna Unsuitable Lands Petition.
- Zamzow, KL. 2009. Water management issues at the proposed Chuitna coal mine – comments on SMCRA.

Chickaloon Village Tribal Council, Wishbone Hill and Jonesville mines, Alaska. Assisted in writing a grant to sample water near the proposed Wishbone Hill coal mine; designed and participated in sampling and data analysis. Technical reviews of water quality and air quality data related to mining, water use, and air permits at proposed coal mines. 2011-2014.

- Zamzow, KL. 2012. Comments on exploration permit renewal, Wishbone Hill coal mine, 3p.
- Zamzow, KL. 2011. Comments on renewal of mining permit at Wishbone Hill coal mine, 23p.
- Zamzow, KL. 2010. Comments to Alaska DNR regarding renewal of the Jonesville Coal Mine permit, 10p.
- Zamzow, KL. 2010. Comments on renewal of permit for exploration at the Wishbone Hill Coal mine, 2p.

Castle Mountain Coalition, Chickaloon mine, Alaska. Assisted in reviewing a coal lease offering. 2012.

Alaskans for Energy Freedom, Beluga project, Alaska. Provided analysis of and report on the history of underground coal gasification and potential environmental issues with a project at Beluga, Alaska. 2010.

- Zamzow, KL. 2010. Underground coal gasification – history, environmental issues, and the proposed project at Beluga, AK. 40p.

Mercury

Quicksilver Summit. Participated with federal and state agencies and university personnel in the planning and development of a public forum on mercury research related to Alaska, with the goal of developing a statewide monitoring plan. Provided technical comments and participated in a panel on biogeochemical cycling of mercury in the environment, particularly related to bacterial transformation of mercury species. October 2010.

- Zamzow, KL. 2010. Mercury on the move: mercury cycling in Alaska, 16p powerpoint.

Alaskans for Energy Freedom, Anchorage, Alaska. Performed literature review on mercury sources, fate, and cycling in environmental media, subsistence foods, and humans in Alaska.

- Zamzow, KL. 2010. Coal and mercury in Alaska: an environmental research and position paper, 54p.

Kendra L. Zamzow, Ph.D.

Earthworks, federal mercury emissions regulations. Reviewed draft regulations proposed to control mercury emissions from mining operations and participated in technical discussions with Washington DC EPA and local and national environmental groups.

- Zamzow, KL. 2010. Comments on national emissions standards for hazardous air pollutants: gold mine ore processing and production area source category. Comments on proposed EPA regulations. 13p.

Non-mining projects

Wrangell Cooperative Association, Wrangell junkyard monofill. Assisted tribe in review of remediation and planned final containment of lead-contaminated soil. Interacted with state Department of Environmental Conservation in identifying characterization and monofill design. 2018.

- Zamzow, K. 2018. Comments on Wrangell junkyard cleanup, 20p.

Water Quality Regulations

Member of the Alaska Department of Environmental Conservation Technical Working Group to provide recommendations on changing statewide water quality regulations for the protection of Human Health with a goal of more stringent regulations to account for the greater consumption of fish and seafood by tribes and rural populations. Final draft recommendation report is pending. Multi-year, multi-stakeholder process. 2015-2018.

Hydraulic Fracturing

AAAS S&T Fellowship. Assisted in research and writing for the EPA Office of Research and Development/Office of Science Policy report on Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Co-organized and co-presented a 2-day workshop for federal agency personnel on the Energy-Water nexus, with a focus on hydraulic fracturing. 2012-2013.

Professional publications

Zamzow, K. "Freshwater ecosystems – water quality of the Nushagak and Kvichak watersheds" in "Bristol Bay Alaska: Natural Resources of the Aquatic and Terrestrial Ecosystems", CA Woody, ed. J Ross Publishing, Florida.

Luo, Q, TK Tsukamoto, GC Miller, and KL Zamzow. 2008. *Arsenic, selenium, and sulfate removal using an ethanol-enhanced sulfate reducing bioreactor.* Mine Water and the Environment 27: 100-108

Zamzow, KL, TK Tsukamoto, and GC Miller. 2006. *Waste from biodiesel manufacturing as an inexpensive carbon source for bioreactors treating acid mine drainage.* Mine Water and the Environment 25: 163-170.

Zamzow, KL, RJ Scrudato, DO Carpenter, and PK Miller. 2002. *Contaminants in people and wildlife on St. Lawrence Island.* Alaska Community Action on Toxics. Anchorage, AK.

Select Presentations

Zamzow, KL. 2017. *Closed loop for AMD treatment waste.* International Mine Water Association, Lappeenranta, Finland.

Zamzow, KL. 2016. *Impacts of exploration: Pebble copper deposit.* American Geophysical Union annual national conference, San Francisco, CA.

Zamzow, KL. 2016. *Water before the mine: collecting baseline samples.* Western Mining Action Network, San Carlos, AZ.

Kendra L. Zamzow, Ph.D.

Zamzow, KL. 2016. *Who's in, who's out, and beyond fish consumption ratios*. Southeast Environmental Conference, Central Council of Tlingit and Haida. Ketchikan, AK.

Zamzow, KL. 2015. *Hardrock mining: from contaminants to comments*. Southeast Environmental Conference, Central Council of Tlingit and Haida. Juneau, AK

Zamzow, KL. 2013. *Rules of engagement: communicating science around political hot potato issues*. Geological Society of America, Denver, CO.

Zamzow, KL. 2011. *Big mines and wild fish: how regulations in Alaska are changing, and implications for fisheries*. Society for Environmental Toxicology and Chemistry, annual meeting of the Pacific Northwest regional chapter. Vancouver, WA.

Zamzow, KL, CA Woody, D Bogan, and A Maest. 2011. *The waters of the Nushagak and the fish that love them: independent environmental baseline studies near the proposed Pebble mine in Alaska*. Society for Environmental Toxicology and Chemistry, annual meeting of the Pacific Northwest regional chapter. Vancouver, WA.

Zamzow, KL. 2010. *Independent water quality characterization of the Pebble project area in Southwestern Alaska*. Geologic Society of America. Denver, CO.

Zamzow, KL. 2010. *Mercury on the move – mercury cycling in Alaska*. Quicksilver summit. Girdwood, AK.

Zamzow, KL. 2010. *Coal's chemical insults on water and fish*. River Rally, Snowbird Resort, Utah.

Zamzow, KL. 2010. Alaska's clean water: at a policy crossroads. Public Interest Environmental Law Conference. Eugene, OR.

Zamzow, KL and CA Woody. 2009. *Mining impacts on fisheries: focus on Pebble*. National Marine Fisheries Service, Southwest Research Center, Santa Cruz, CA.

Zamzow, KL. 2009. *Gold mining and mercury*. Association of Village Council Presidents meeting. Bethel, AK.

Zamzow, KL. 2009. *Sulfide mines: the science and the risk*. Oral presentations sponsored by the Native non-profit Nunamta Aulukestaii, given at Pedro Bay, Kokhanok, Dillingham, Togiak, Tyonek and Palmer, AK.

Zamzow, KL, GC Miller, and TK Tsukamoto. 2008. *Acid mine drainage – chemistry, remediation, and impacts*. American Fisheries Society. Anchorage, AK.

Zamzow, KL and GC Miller. 2007. *Alcohol bioreactor treating acid mine drainage, using biodiesel waste as a carbon source*. International Mine Water Association. Cagliari, Italy.

Zamzow, KL, TK Tsukamoto, and GC Miller. 2006. *Biodiesel and bioreactors: finding ways to recycle industrial waste*. American Chemical Society, Green Chemistry Division. Washington, DC.

Professional Organizations

Associate Editor, "Mine Water and Environment", a journal of the International Mine Water Association
Member and Fellow, American Association for the Advancement of Sciences
Member American Geological Union, American Fisheries Society

APPENDIX 3

REPORT OF SARAH O'NEAL

REPORT OF SARAH O'NEAL

I. BACKGROUND

1. I am a fish biologist and a Ph.D. student at the University of Washington's School of Aquatic and Fishery Sciences. My research focuses on the toxicity of metals resulting from hard rock mining to fishes, as well as assessment of sub-lethal and indirect ecological effects of mine waste.

2. I have 20 years of experience in freshwater ecology in salmon ecosystems, working in the private, public, and non-governmental sectors, including a combined ten years of experience in British Columbia and Alaska. In British Columbia, I conducted academic research of salmon ecosystems as part of an international effort to characterize essential freshwater habitat. In Alaska, I conducted research for the same international effort throughout the state, and currently conduct ongoing habitat monitoring efforts of salmon ecosystems in a region proposed for mining in Bristol Bay. In addition to basic research, I conduct reviews of technical documents related large scale development (e.g., mining, hydropower development) and impacts to aquatic habitat in both British Columbia and Alaska. I also conduct outreach regarding my work to diverse audiences including lawmakers, aboriginal interests, other scientists, and the general public.

3. I have a Bachelor's Degree in Ecology, Evolution, and Conservation Biology from the University of Washington, and a Master's Degree in Organismal Biology and Ecology with an emphasis in freshwater ecology from the University of Montana's Flathead Lake Biological Station.

4. Through my education, research and professional activities, I have developed expertise in water chemistry, toxicology, aquatic plants, diatoms, zooplankton, macroinvertebrates, resident and anadromous fishes, and interactions between them in both lakes

and streams. This expertise allows me to evaluate the environmental impacts of metals concentrations in fish habitat.

5. My *curriculum vitae* is attached to this statement.

6. I have been asked by the Southeast Alaska Indigenous Transboundary Commission (SEITC) and Earthjustice to offer my opinion on whether six mine projects in the British Columbia-Alaska transboundary watersheds—the Tulsequah Chief Mine in the Taku watershed; the Red Chris, Schaft Creek and Galore Creek mines in the Stikine watershed; the KSM and Brucejack mines within the Unuk watershed—could pose risks to downstream fish populations. In order to analyze the risks posed, I focused on the KSM Mine project in the Unuk River watershed. To date, the KSM Mine project is alone among the B.C. Mines in offering predicted water quality levels for waters inhabited by fish. The KSM Mine therefore serves as an example of the situation posed by the B.C. Mines more generally.

II. FISH POPULATIONS IN THE UNUK RIVER WATERSHED

7. The Unuk River system supports six species of Pacific salmon, which are essential to the regional economy, subsistence lifestyles, and overall ecosystem integrity. These species include Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), chum (*O. keta*), pink salmon (*O. gorbuscha*), and steelhead (*Oncorhynchus mykiss*).¹

8. Pacific salmon are anadromous, meaning they reproduce and incubate in freshwater, but spend some part (usually the majority) of their lives rearing in the marine environment. Salmon eggs typically incubate over winter, often relying on groundwater input in harsh northern environments where surface waters freeze.² In the spring, juvenile salmon called

¹ Johnson and Blossom 2017, Rescan Environmental Services Ltd. 2013

² Reynolds 1997

“fry” hatch from eggs and emerge from gravel. Some species (pink and chum salmon) fry typically migrate immediately to the sea. Other species (steelhead, Chinook, silver, and sockeye salmon) fry remain in a variety of freshwater environments. Fry remaining in freshwater mature into “parr,” which rely heavily on freshwater zooplankton and/or insects for food. Parr may remain in freshwater from less than one up to at least four years.

9. As fry or parr prepare to migrate to sea, they enter the “smolt” life stage. Smoltification is a highly complex process involving physiologic changes in body shape and osmoregulation (maintenance of salt and water balances across cell membranes). Once at sea, smolts mature as they gain the vast majority of their body weight (>90%). They stay at sea for one or more years.

10. Upon maturation, adult salmon return to their natal streams to reproduce. Because of the diversity of life histories both within and across species, each year can see multiple spawning runs from each species of salmon. A run can range from thousands to millions of fish.

11. In general, salmon precisely “home” to their natal environment to spawn within meters to kilometers from where they hatched. As a result, a diverse array of stocks develops within and across watersheds and species. Each stock is uniquely adapted to the subtleties of its own environment. The diversity, or “biocomplexity,” is essential to the long-term sustainability of salmon populations as a whole.³ Environmental conditions inevitably vary, so decreases in some stocks are buffered by increases in others.⁴ Maintenance of salmon biocomplexity is essential to the conservation of Pacific salmon and requires intact, natural environmental conditions.

³ Hilborn et al. 2003

⁴ Schindler et al. 2010

12. Returning salmon deliver large marine-derived nutrient pulses to often otherwise nutrient-poor environments. Consequently, salmon ecosystems have evolved to depend heavily on salmon returns as a primary source of nitrogen, phosphorus and other nutrients essential to all life. It is for this reason that salmon are considered a “keystone species,” meaning that they play a crucial role in ecosystem function.

Chinook Salmon

13. Chinook (king) salmon are typically the earliest of the Pacific salmon species to spawn, usually between late July to early September. After eggs incubate over winter, juveniles emerge in spring and usually spend one year rearing in tributaries or in the mainstem. Smolts leave freshwater in April or May before returning to spawn mostly as 5-year-old or 6-year-old fish.⁵ Consequently, one or more life stages of Chinook salmon inhabit the Unuk River watershed during all months of the year.

14. In the Unuk River watershed, Chinook spawning has been documented as close as 3 km (~ 2 mi) downstream of the Canadian border and Chinook presence has been documented up to the border.⁶ Chinook presence has been documented in headwater streams draining the area that would be the footprint of the proposed KSM Mine on the Canadian side of the border.⁷

15. Chinook spawner abundance (or escapement) here has been estimated using a combination of aerial surveys and mark-recapture techniques. Estimates ranged from 2,782 to 10,541 large spawners (>660 mm or 28") between 1977 and 2008, with an average of 5,403 large kings since 1977.⁸ Overall population productivity (recruits per spawner, or the average number of surviving adult offspring produced by each spawner) was estimated between 0.3 and 3.6

⁵ Groot and Margolis, 1991

⁶ Johnson and Blossom 2017

⁷ Rescan Environmental Services Ltd. 2013

⁸ Weller and Evans 2012b

between 1981 and 1998, with an average of 1.5.⁹ Recruit per spawner ratios in excess of 1 indicate overall population growth, while ratios less than 1 indicate population decline.

16. Since 2008, spawning escapement and likely overall productivity have declined precipitously. Management goals for escapement were not met for four of the five years between 2012 and 2016, and investigations are underway to identify potential causes of recent declines.¹⁰ Recent work found that Unuk River and other Alaskan Chinook salmon are spawning younger (5-year old spawners are declining while 4-year old spawners are increasing) and at smaller sizes (the length of both age classes is decreasing).¹¹ This suggests a potential reduction in life history diversity (biocoomplexity) essential to maintaining overall sustainability of Chinook salmon.

17. Smolt abundance was also estimated for Unuk Chinook between 1992 and 2006 using tagging methods, which allowed for estimates of: overwinter survival for juvenile Chinook in the freshwater environment; smolt survival in the marine environment; and overall population productivity (i.e., recruit per spawner ratios). Overwinter survival estimates were highly variable, ranging from 27-83% percent and averaging 57 percent. Marine survival estimates ranged from less than 1 percent to nearly 4 percent, and averaged about 2.5 percent.¹²

18. All told, the data suggest that it is more likely that the marine environment is more limiting to Unuk Chinook populations than freshwater rearing habitat. The specific causes of marine limitations are yet to be explicitly identified.

⁹ Hendrich et al. 2008

¹⁰ Richards 2017, ADFG, personal communication

¹¹ Ibid.

¹² Weller and Evans 2012a

Coho Salmon

19. Coho (or silver) salmon are usually the latest of the Pacific salmon species to spawn, with peak spawning typically in August and September. Spawning may begin as early as July and last as late as November in the region.

20. After incubating over winter, juveniles emerge in spring and generally spend one to three years rearing typically in tributary or off-channel habitats (e.g., side channels, springs, brooks, etc.). Smolts leave the system in spring and may spend anywhere between six months (for undersized, but sexually mature males, known as “jacks”) to 18 months (more commonly) in the ocean.¹³

21. One or more life stages of coho salmon inhabit the Unuk watershed during all months of the year. In the Unuk, coho spawning has been documented as close as 8 km (~ 5 mi) downstream of the Canadian border.¹⁴ Coho presence has also been documented in the KSM Mine area in the Unuk watershed.

22. As compared to Chinook salmon, significantly less is known about coho salmon abundance in the Unuk watershed. Escapement estimates ranged from 12,422-57,610 and averaged 30,420 between 1998 and 2002 when mark-recapture studies were conducted.¹⁵ Currently, no coho salmon escapement goals are set for the Unuk River.¹⁶

Sockeye Salmon

23. Sockeye (or red) salmon typically spawn in July and August. After incubating over winter, most juveniles emerge in spring and generally spend at least one year rearing in freshwater lake habitat before migrating to the marine environment. Some juveniles (known as

¹³ Groot and Margolis 1991

¹⁴ Johnson and Blossom 2017, Rescan

¹⁵ Shaul et al. 2003

¹⁶ Ibid.

“river-rearing sockeye) rear in streams before smoltification, while the majority migrate to lakes where they spend most commonly spend one to three years before migrating to sea. Smolts leave the system in spring and may spend anywhere between six months (in the case of male jacks) to three years in the ocean, returning between the ages of 3 and 6 years old.

24. One or more life stages of sockeye salmon likely inhabit the Unuk River watershed during all months of the year.¹⁷ In the Unuk, sockeye have been documented up to the Canadian border by Alaska biologists.¹⁸ Sockeye presence has also been documented in the KSM Mine area in the Unuk watershed.¹⁹

25. Little is known about sockeye salmon abundance in the Unuk River. There are no major rearing lakes in the Unuk watershed, and sockeye comprise a small percentage (<4 percent) of the commercial salmon harvest.²⁰ Currently, no sockeye salmon escapement goals are set for the Unuk River.

Pink Salmon

26. Unlike other Pacific salmon species, pink (or humpy) salmon complete their life cycle in two years. In doing so, they create two genetically distinct populations of odd- and even-year spawners within one river system important to maintaining the biocomplexity required for pink salmon population sustainability. Pink salmon typically spawn between late June and mid-October.

27. After incubating over winter, fry emerge in spring and immediately migrate downstream to the marine environment. They spend about a year and a half in the ocean before returning at the age of two.

¹⁷ Johnson and Blossom 2017, Levy 2006

¹⁸ Johnson and Blossom 2017

¹⁹ Rescan Environmental Services Ltd. 2013

²⁰ McDowell Group 2016

28. One or more life stages of pink salmon inhabit the Unuk River watershed for most of the year (with the exception of emergence/smoltification in spring until spawning begins in about June). In the Unuk River, pink spawning has been documented up to the Canadian border.²¹

29. Pink salmon abundance is less well-documented for the Unuk River compared to Chinook and coho abundance. Average harvest of pinks between 2005-2014 was 32,000 fish and ranged from 5,000 to 70,000.²² No escapement data or escapement goals were located for the Unuk watershed.

Chum Salmon

30. Chum (or dog) salmon spawn in fall. After emerging in spring, they begin their seaward migration within days to weeks. At sea, chum spend 3-4 years before returning to their natal habitat to spawn. Consequently, chum salmon are present in the Unuk River watershed from fall to spring. In the Unuk, chum have been documented spawning up to the Canadian border.²³

31. Abundance of chum salmon in the Unuk River is less well-documented than for Chinook and coho abundance. Average harvest of chum between 2005-2014 was 10,000 fish and ranged from 6,000 to 14,000.²⁴ No escapement data or escapement goals were located for the Unuk watershed.

Rainbow and Steelhead Trout

32. Rainbow trout/steelhead exhibit the most diverse life history of all Pacific salmon. Unlike other Pacific salmon, they spawn in the spring (typically March to July), and emerge as

²¹ Johnson and Blossom 2017

²² McDowell Group 2016

²³ Johnson and Blossom 2017

²⁴ McDowell Group 2016

juveniles weeks to months later in the summer. Juvenile rainbow/steelhead may spend weeks, months, or years in freshwater. Similarly, they may spend weeks, months, or years in the marine environment. Those that remain in freshwater for their entire life history are considered rainbow trout. Those that spend some aspect of their life history in the marine environment are considered steelhead.

33. Both rainbow trout and steelhead can spawn multiple times in their lives, unlike other Pacific salmon species.

34. Rainbow trout and/or steelhead have been documented in the KSM Mine area in the Unuk River watershed.²⁵

Dolly Varden

35. In addition to the six species of salmon, the Unuk River is also inhabited by Dolly Varden (*Salvelinus malma*) and eulachon (*Thaleichthys pacificus*).

36. Dolly Varden diverse life histories. In general, Dolly Varden spawn in the fall between September and November. Unlike Pacific salmon, Dolly Varden can spawn multiple (typically no more than three) times during their lives. Fry emerge in early spring. Juveniles can remain in streams, migrate to lakes, or migrate to sea. All life stages of Dolly Varden inhabit freshwater environments like the Unuk watershed during all months of the year, and have been documented in the KSM Mine area.²⁶ Mine proponents indicate Dolly Varden are the most frequently encountered salmonid in the mine area.²⁷ Dolly Varden may be used in subsistence activities and because they typically remain as residents in freshwater, are also used as ecological indicators of freshwater conditions.

²⁵ Rescan Environmental Services Ltd. 2013

²⁶ Ibid.

²⁷ Ibid.

Eulachon

37. Like Pacific salmon, eulachon (hooligan) are anadromous. Unlike Pacific salmon, however, eulachon may not home precisely to the stream or reach where they were spawned but instead seek out optimal habitat for spawning.²⁸

38. Eulachon generally spawn within a few kilometers of the sea in river mouths. Spawning occurs earlier for eulachon than for salmon, typically in March in southern Alaska and northern British Columbia.²⁹ Eggs incubate for three to six weeks before juveniles emerge and immediately migrate downstream to mature in the marine environment for three to six years. Most eulachon die after spawning once.

39. Eulachon play an important ecological³⁰ role in their environment. Eulachon feed seals, porpoises, sea lions, whales, seabirds, and eagles.³¹

40. Furthermore, eulachon are important to subsistence lifestyles in both British Columbia and Alaska. Eulachon are rendered for grease which is a staple to many communities' diets and has served as an important trade commodity for millennia.³²

41. Biologists have observed substantial population declines of eulachon in the last ten years; as a result, personal use fisheries have been closed on the Unuk River.³³ Before the closure, harvests had declined from 7 to 14 tonnes (metric tons) per year to less than one tonne.³⁴ Reasons for declines are poorly understood, but may include overharvest from historic commercial fisheries, marine conditions, or freshwater spawning conditions.³⁵ Only about 14

²⁸ McPhail 2007

²⁹ Ibid.

³⁰ Sigler et al. 2004

³¹ Ibid.

³² Ibid.

³³ Richards 2017, ADFG, personal communication, Moody 2008

³⁴ Moody 2008

³⁵ Richards 2017, ADFG, personal communication

rivers on the eastern Pacific coast/western North America consistently support large eulachon spawning runs, making conservation of those runs essential to overall conservation of the species.³⁶

III. POTENTIAL TOXICOLOGICAL EFFECTS ON FISH RESULTING FROM THE B.C. MINES

42. As Dr. David Chambers' report on the B.C. Mines indicates, these projects pose a threat of surface water pollution. Due to the acid-mine drainage and metals leaching wastes that these projects generate, the B.C. Mines threaten downstream waters with metals pollution.

43. The KSM Mine on the Unuk River is the one project for which downstream metals concentrations in fish-inhabited waters have been predicted. The KSM Mine will generate large volumes of mine wastes, some of which will generate acid and mobilize heavy metals. Although the Mine proponent has described plans to treat waste so as to reduce metals concentrations before waste waters are released to the Unuk watershed, as Dr. Chambers' report explains, increased concentrations of some metals is likely: "the actual ranges of downstream metals concentrations are likely to exceed baseline levels, including in the Unuk River, and the increase could be substantial. This opinion is based on the probability that containment and treatment systems will not operate seamlessly and consistently to reduce effluent concentrations to maintain baseline water quality, especially for the treatment systems that have been proposed, like for selenium, but have not demonstrated their effectiveness at a commercial scale."³⁷

44. As an illustration of the potential risks posed by the B.C. Mines, the following section examines some metals which are likely to increase in association with mining activity, as

³⁶ McPhail 2007

³⁷ Chambers statement at § 65

well as their potential toxicological effects to fish and other aquatic life downstream of the KSM Mine.

45. The field of toxicology addresses the potential harmful effects of chemicals on living organisms.³⁸

46. The vast majority of toxicological research is based on laboratory tests used to determine direct effects, or concentrations of chemicals at which deleterious effects occur to a test organism in laboratory conditions. Lethality is the most commonly measured direct effect of chemicals, though effects on growth, reproduction, brain function, and blood chemistry are just some additional examples. Direct effects measured in lab testing can be acute, occurring within a short period of time (i.e., hours to days), typically at higher concentrations. Direct effects can also be chronic, occurring over longer periods (days to years). Chronic effects typically occur at lower concentrations than acute effects.

47. Toxicological research also investigates indirect effects of substances upon organisms. An organism experiences an indirect effect when a substance effects a change to a component of an ecosystem, which in turn affects the organism. Examples of indirect effects include reduced salmonid abundance due to toxic effects on food species like zooplankton or aquatic insects, or due to toxic effects on plants that provide habitat structure. Unfortunately, indirect effects are more difficult to measure, and consequently they are far less understood and documented than direct effects.

48. One category of substances that has been studied in toxicological research is metals.

³⁸ Rand 1995

49. Within the field of toxicology, metals are generally divided into essential and non-essential. Essential metals are metals an organism needs for life. For example, a metal might be required as a component of necessary proteins, amino acids, or cell production processes. It is important for survival that organisms experience optimal levels of essential metals for physiologic function. Generally, biota exhibit symptoms of deficiency at low concentrations of essential metals; however, they can also experience toxicity at high concentrations.

50. Non-essential metals are metals that are not required (or not known to be required) for healthy physiologic function of organisms. Where concentrations of non-essential metals are sufficiently low, organisms can excrete or otherwise mitigate exposure. At high concentrations, non-essential metals can be toxic to organisms.

51. Metals can be toxic to fish and other aquatic life at lethal and sub-lethal levels, and through direct and indirect pathways.

52. The toxicological effect of metals on fish is a function of the metal's concentration as well as a host of other variables. These include the alkalinity of ambient waters. Low alkalinity streams provide little buffering capacity to neutralize acidic mine waters. The amount of dissolved organic carbon (DOC) present in the water is also an important variable. A lack of DOC limits the ability of waters to assimilate metals, meaning that metals molecules in low-DOC waters remain in a form that more easily bonds with biological receptors and thus are more toxic to aquatic life.³⁹ Other variables affecting speciation and behavior of metals in freshwater include (but are not limited to): temperature, pH, dissolved oxygen concentrations,

³⁹ Ibid.

hardness (calcium and magnesium levels in waters which generally reduce metals toxicity with increasing hardness), and duration of exposure.

53. In order to isolate effects of an individual metal, studies of metal toxicity often hold other variables constant. The results from laboratory investigations are thus not precisely applicable to natural environments. In the absence of information about variables such as alkalinity, dissolved organic carbon, and temperature, it is not possible to precisely predict what toxicological effects would result from a given concentration of any metal.

54. It is possible, however, to describe a range of possible effects that could result from metals contamination given expected concentrations. Current, background concentrations of some metals in the Unuk River are near or in excess of water quality guidelines based on aquatic toxicological thresholds (including aluminium, cadmium, copper, selenium and zinc). The following section of this report describes what, in my expert opinion, are potential direct and indirect toxicological effects of the increases of those metals concentrations on fish downstream which could ultimately lead to population-level impacts, meaning significant and sustained decreases of the population's size. In light of uncertainties inherent to water chemistry-related and toxicological predictions, in addition to potential unplanned accidents including spills, the following description of effects is conservative.

Aluminum

55. An increase in aluminum concentrations relative to baseline levels in waters downstream of an operational KSM Mine could have harmful effects on salmonid and potentially eulachon populations.

56. Aluminum is an element that is geologically abundant, but is non-essential to fish.⁴⁰ Exposure to aluminum at concentrations above baseline levels within the Unuk River could potentially be deleterious to all forms of aquatic life.

57. Aluminum can be lethally toxic to fish on the basis of two physiological processes. First, aluminum can disrupt a fish's ionoregulatory processes, meaning it would disrupt salt and water balances across the gill and other cellular membranes. Second, aluminum can disrupt a fish's respiratory system, leading to clogging of gills by mucus at high aluminum concentrations. The result would be insufficient oxygen exchange, hyperventilation and eventually suffocation.

58. As with all metals discussed here, higher concentrations are more harmful to aquatic life. Even when these impacts occur below lethal levels they can be harmful to fish. By accumulating on the gill surface, aluminum can cause mucous production to increase by up to four times normal levels, inhibiting respiration.⁴¹ Stress associated with impaired respiration can inhibit the ability of salmonids to deal with additional stressors, including natural stressors like smoltification.⁴² For example, juvenile Atlantic salmon (*Salmo salar*, a species that share the *Salmonidae* family with Pacific salmon) exposed to aluminum exhibited a 20-30% reduction in survival⁴³ and reduced seawater tolerance.⁴⁴ In addition, aluminum can reduce salmonid growth rates and swimming speeds.⁴⁵ Aluminum can also impair salmonid olfaction which is critical to locating predators and prey, mates and kin, and homing to natal streams.⁴⁶ Interference with any

⁴⁰ Gensemer and Playle 1999

⁴¹ Wilson et al. 1994

⁴² Dennis and Clair 2012

⁴³ Krogland and Finstad 2003

⁴⁴ Monette et al. 2008

⁴⁵ Wilson and Wood 1992, Wilson et al. 1994

⁴⁶ Klaprat et al. 1988

of these processes essential to survival and successful reproduction could ultimately lead to population-level impacts, meaning significant and sustained decreases of the population's size.

59. Larvae emerging from gravels may be the most sensitive salmonid life stage to aluminum,⁴⁷ which is concerning given that all six salmonid species as well as Dolly Varden and cutthroat trout (*Oncorhynchus clarkii*) incubate in the gravels around and downstream of the KSM Mine site. Salmonids have demonstrated an ability to acclimate to increased aluminum concentrations in laboratory environments,⁴⁸ however a metabolic cost may be associated with acclimation.⁴⁹

60. Aluminum can also indirectly harm fish. Aluminum has deleterious effects on freshwater zooplankton and insects known to be important food sources for salmonids.⁵⁰ Aluminum is also toxic to algal species which form the base of the aquatic food web and are a main diet item for many macroinvertebrate species. Consequently, deleterious effects of aluminum pollution can reverberate throughout the food web with ultimately negative impacts on salmonid growth and survival, particularly for those species which spend time rearing in freshwater (i.e., Chinook, coho, sockeye, rainbow/steelhead, and Dolly Varden).

61. Calcium, or increased water hardness, can provide some protection against aluminum toxicity. Precise data are lacking, but reported hardness levels near the KSM mine site are low.⁵¹

62. In my expert opinion, increased aluminum concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained

⁴⁷ Delonay et al. 1993

⁴⁸ Orr et al. 1986

⁴⁹ Wilson and Wood 1992

⁵⁰ Gensemer and Pyle 1999

⁵¹ Gensemer and Pyle 1999, Rescan Environmental Services Ltd. 2013

decreases of salmon, trout, and eulachon populations in the Unuk River. As with all metals discussed here, higher concentrations are more harmful to aquatic life.

Cadmium

63. An increase in cadmium concentrations relative to baseline levels in waters downstream of an operational KSM Mine could have harmful effects on salmonid and potentially eulachon populations.

64. Cadmium is a non-essential element for fish. It can be extremely toxic to aquatic life. As with all metals discussed here, higher concentrations are more harmful to aquatic life

65. Exposure to cadmium in fish occurs primarily through water in the gill and kidney (waterborne exposure) or in the intestine (dietary exposure).⁵² Cadmium mimics calcium, in that it is similar in structure and ionic strength; the result is that cadmium inhibits calcium uptake. Calcium is biologically essential to fish. Therefore, sufficient cadmium concentrations cause deleterious effects which can ultimately be lethal.⁵³

66. Sublethal physiological impacts of cadmium exposure include reduced growth and condition factor (unit weight per unit growth; an index of fish health).⁵⁴

67. Reproduction is also impacted, with impaired egg development and premature hatching.⁵⁵

68. Immune response may be depressed after cadmium exposure as evidenced by elevated stress chemicals in exposed salmonids.⁵⁶

⁵² Franklin et al. 2005

⁵³ McGeer et al. 2011

⁵⁴ Riddell et al. 2005, Lizardo-Daudt and Kennedy 2008

⁵⁵ Lizardo-Daudt and Kennedy 2008

⁵⁶ Ricard et al. 1998

69. Cadmium also induces neurotoxic effects in fish including hyperactivity leading to decreased growth and increased detection by predators.⁵⁷ Examinations of life-stage sensitivity suggest that emerging fry are most sensitive in Chinook salmon, while emerging fry and rearing parr are equally sensitive to cadmium in rainbow/steelhead.⁵⁸

70. Documented behavioral effects of cadmium on salmonids include a diminished ability to avoid predators—possibly due to olfactory inhibition,⁵⁹ diminished foraging success,⁶⁰ and altered social behavior including less aggressive competition.⁶¹ At extremely elevated cadmium levels, salmonids have been documented avoiding waters altogether.⁶²

71. Cadmium can also harm fish through indirect pathways. Salmonids are more sensitive to acute levels of cadmium toxicity than aquatic macroinvertebrates or other fishes.⁶³ However invertebrates (particularly amphipods) are more sensitive to chronic exposures of cadmium.⁶⁴ Where there is chronic cadmium exposure, fish will have fewer invertebrates to feed upon. Its deleterious effects can reverberate throughout the food web with ultimately negative impacts on salmonid growth and survival, particularly for those species which spend time rearing in freshwater (i.e., Chinook, coho, sockeye, rainbow/steelhead, and Dolly Varden).

72. Waters naturally high in calcium (i.e. naturally hard waters) ameliorate the toxic effects of cadmium. Waters draining the KSM deposit, however, exhibit low calcium levels.

⁵⁷ Ibid.

⁵⁸ Chapman 1978

⁵⁹ Scott et al. 2003

⁶⁰ Riddell 2005

⁶¹ Sloman et al. 2003

⁶² Mebane 2010

⁶³ Farag 2003, Mebane 2012

⁶⁴ Mebane 2010

73. Dissolved organic matter can also decrease the bioavailability or overall toxicity of cadmium. However, the Unuk River drainage supports low dissolved organic matter based on low total organic carbon reported by mine proponents.⁶⁵

74. In my expert opinion, increased cadmium concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River. As with all metals discussed here, higher concentrations are more harmful to aquatic life.

Copper

75. An increase in copper concentrations relative to baseline levels in waters downstream of an operational KSM Mine could have harmful effects on salmonid and potentially eulachon populations.

76. Copper is an essential element for fish that frequently increases in areas with active sulphide mining. It is one of the most pervasive and toxic elements to aquatic life, and has been documented at levels one to three orders of magnitude greater than background in mining areas.⁶⁶ Copper is utilized in growth and metabolism of all aerobic organisms. Because it is essential to biological function, it is readily incorporated into fish tissues.

77. Fish are primarily exposed to copper through water in the gill, kidney, olfactory receptors, and lateral line cilia (waterborne exposure), or in the intestine (dietary exposure).⁶⁷ As with all metals discussed here, higher concentrations are more harmful to aquatic life

78. Olfactory inhibition resulting from copper exposure occurs within minutes and lasts for weeks or longer, with the potential to affect all aspects of salmonid biology.⁶⁸ It is

⁶⁵ Rescan Environmental Services Ltd. 2013, Tbl. 14.1-1

⁶⁶ Grosell 2011

⁶⁷ Ibid.

⁶⁸ Ibid.

known to reduce growth, immune response, reproduction, and survival.⁶⁹ Specific examples of toxic effects include disrupted migration; altered swimming; oxidative damage; impaired respiration; disrupted osmoregulation and pathology of kidneys, liver, gills, and other stem cells; impaired mechanoreception of lateral line canals; impaired function of olfactory organs and brain; and altered behavior, blood chemistry, enzyme activity, the endocrine system, and gene transcription and expression.⁷⁰ The effects have been demonstrated for juvenile and adult life stages primarily of coho and Chinook salmon and rainbow trout.

79. Many sublethal effects of copper are identical to those causing mortality. Physiological effects of Copper exposure include decreased growth, swimming speed or activity, and feeding rates.⁷¹ Coho salmon exhibit diminished immune response after exposure to copper.⁷² Reproductive performance also decreases in adult salmonids exposed to copper.⁷³

80. Very slight increases in copper concentrations (5-25 parts per billion) inhibit olfaction in coho and Chinook salmon and rainbow trout, with potential to inhibit recognition of predators, prey, mates, kin, and natal streams.⁷⁴ Chinook salmon and rainbow trout avoid copper contaminated waters altogether, except after long-term sublethal copper exposure, after which their avoidance response may be impaired.⁷⁵ Avoidance can lead to degradation of spawning patterns and resulting genetic diversity which are essential to maintaining overall population structure and sustainability. Adult spawning migrations are delayed or interrupted in copper contaminated streams, and downstream smolt migration is likewise delayed and osmoregulation

⁶⁹ Eisler 1998

⁷⁰ Hodson et al. 1979, Knittel 1981, Rougier et al. 1994, Eisler 2000, Craig et al. 2010, Tierney et al. 2010

⁷¹ Waiwood and Beamish 1978a, Waidwood and Beamish 1978b, Marr et al. 1996

⁷² Stevens 1977, Schreck and Lorz 1978

⁷³ Jaensson and Olsen 2010.

⁷⁴ Hansen et al. 1999, Sandahl et al. 2007, Baldwin et al. 2011, McIntyre et al. 2012

⁷⁵ Hansen et al. 1999, Meyer and Adams 2010

of smolts in seawater is impaired.⁷⁶ Copper-exposed salmon are also more vulnerable to predation.⁷⁷

81. Copper can also harm fish through indirect pathways. Numerous studies document adverse effects of copper on freshwater algae, zooplankton, mussels, and other invertebrates, which could result in reduced prey abundance and quality to support fish growth and reproduction.⁷⁸ Copper is one of the most toxic metals to algae, which form the base of the salmonid food chain. Algae production can decline with copper increases of only 1-2 parts per billion (ppb).⁷⁹ Zooplankton and other invertebrates that rely on algae for food suffer decreased growth and reproduction when primary production decreases.⁸⁰ Zooplankton and lotic macroinvertebrates are also extremely sensitive to copper increases.⁸¹

82. Copper toxicity increases in acidic conditions, soft waters (low hardness), and in waters depauperate of dissolved organic matter—which occur in waters draining the KSM deposit.

83. In my expert opinion, increased copper concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River. As with all metals discussed here, higher concentrations are more harmful to aquatic life.

⁷⁶ Lorz and McPherson 1976, Schreck and Lorz 1978, Hecht et al. 2007

⁷⁷ Sandahl et al. 2007, McIntyre et al. 2012

⁷⁸ Woottton 1990, Scannell 2009

⁷⁹ Franklin et al. 2002

⁸⁰ Urabe 1991

⁸¹ Farag 1998, Zipper et al. 2016

Selenium

84. An increase in selenium concentrations relative to baseline levels in waters downstream of the KSM Mine could have harmful effects on salmonid and potentially eulachon populations.

85. Selenium is an element essential to fish, including for protein synthesis. It is also one of the most hazardous elements to fish at high concentrations. The margin between essentiality and toxicity of selenium is very slim.⁸² As with all metals discussed here, higher concentrations are more harmful to aquatic life

86. Anthropogenic activity rarely causes acute toxicity for fish. Chronic selenium exposure, however, is teratogenic (causing malformation) to early life stages of fish (i.e., embryos, alevins, and fry).⁸³

87. Unlike other metals, toxic effects occur primarily through dietary as opposed to waterborne pathways. Unlike most trace elements, selenium bioaccumulates (accumulates faster than metabolic or excretory loss) and sometimes biomagnifies (increases in animal tissue at successively higher levels of the food chain). Bioaccumulation and biomagnification cannot be predicted from selenium concentrations, making sufficiently protective water quality guidelines exceedingly difficult to estimate. Since diet is the primary source of selenium to fish, its efficient uptake by algae and macroinvertebrates contributes to selenium toxicity. Interestingly, algae and invertebrates themselves exhibit little sensitivity to selenium exposure.⁸⁴ Consequently, relatively low selenium concentrations can lead to fish toxicity via bioaccumulation.

⁸² Janz 2011

⁸³ Lemly 2004

⁸⁴ Ibid.

88. Adult life stages are relatively tolerant of dietary selenium intake, but can pass its effects to offspring.⁸⁵ Selenium is deposited into eggs during their formation resulting in deformations typically in the skeleton, skull, or fins.⁸⁶

89. Few studies have investigated sublethal selenium effects. Avoidance of selenium-contaminated waters has not been documented, nor have changes in reproductive behavior of fishes in increased selenium concentrations.⁸⁷ In one study, swimming speed, frequency, and distance were reduced after selenium exposure in non-salmonid fishes.⁸⁸

90. Population level effects of selenium contamination have been documented in multiple freshwater ecosystems, though further investigation is needed. In multiple case studies, the majority of fish species have been extirpated as a result of selenium exposure.⁸⁹

91. In my expert opinion, increased selenium concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River. As with all metals discussed here, higher concentrations are more harmful to aquatic life.

Zinc

92. An increase in zinc concentrations relative to baseline levels in waters downstream of the KSM Mine could have harmful effects on salmonid and potentially eulachon populations.

93. Zinc is an essential element used by vertebrates in the synthesis of proteins, including hemoglobin. However, at high enough concentrations, zinc can be harmful to fish.

⁸⁵ Janz 2011

⁸⁶ Ibid.

⁸⁷ Ibid.

⁸⁸ Ibid.

⁸⁹ Lemly 2004, Janz 2011

Fish kills and/or the absence of fish (including salmonid) species are commonly associated with elevated zinc, copper, and cadmium concentrations downstream of mining activity.⁹⁰ As with all metals discussed here, higher concentrations are more harmful to aquatic life

94. Like cadmium, zinc mimics calcium, inhibiting its uptake. Such inhabitation can be lethal.⁹¹ Waterborne exposure competitively inhibits calcium, binding to sites on fish gills and leading to impaired gas exchange, gill inflammation, and ultimately suffocation, or decreased survival, growth, reproduction, and hatching.⁹² Dietary uptake poses lower risk to fish than waterborne exposure, primarily through gills.

95. Increased stress and decreased immune response has been attributed to zinc exposure in rainbow trout.⁹³ Juvenile rainbow trout and other salmonids have also been documented avoiding zinc-contaminated waters.⁹⁴ Other effects of zinc on behavior include increased ventilation and cough rates, altered swimming patterns, and decreased growth.⁹⁵

96. Zinc can have harmful indirect effects on fish as well. Invertebrates are more sensitive to zinc than fish, so decreased feeding opportunities are a likely pathway for indirect effects of zinc.⁹⁶

97. Waters naturally high in cadmium (naturally hard) can ameliorate the toxic calcium-uptake inhibitive effects of zinc. Waters draining the KSM deposit, however, exhibit low calcium levels.

⁹⁰ Farag et al. 2003, Hogstrand 2011

⁹¹ McGeer et al. 2011

⁹² Hogstrand 2011

⁹³ Wagner and McKeown 1982, Sanchez-Dardon et al. 1999

⁹⁴ Hogstrand 2011

⁹⁵ Ibid.

⁹⁶ Santore 2002

98. Dissolved organic matter can also decrease the bioavailability or overall toxicity of zinc. Levels of dissolved organic matter, however, are low in waters draining the KSM Mine area.

99. In my expert opinion, increased zinc concentrations downstream of the KSM Mine could ultimately lead to population-level impacts, meaning significant and sustained decreases of salmon, trout, and eulachon populations in the Unuk River. As with all metals discussed here, higher concentrations are more harmful to aquatic life.

IV. CONCLUSION

100. Because of inherent environmental variability in addition to factors of human error, toxicological effects of an increase in metals concentrations relative to baseline levels downstream of the KSM Mine site simply cannot be precisely predicted. Mine proponents commonly underestimate actual impacts to surface and groundwaters during planning and permitting processes.⁹⁷ Regardless, potential increases of metals concentrations in the Unuk River during KSM Mine operations are ones at which toxicological effects to fish and other aquatic biota are likely to occur. My opinion is that increases in concentrations of already naturally elevated aluminum, cadmium, copper, selenium, and zinc could cause population-level impacts to Unuk River salmon, eulachon, and other fishes, meaning significant and sustained population decreases.

101. Perhaps of most concern are elevated levels of copper, which can harm all life stages of salmonids even at relatively low concentrations, and selenium, which has not been successfully treated at other mine sites and whose ultimate fate cannot be predicted because of its

⁹⁷ Kuipers et al., 2006

bioaccumulative properties.⁹⁸ Furthermore, combinations of multiple metals can have synergistic effects, meaning effects can be greater than the sum of the effects of individual metals.

102. My review also does not include consideration for myriad additional aspects of mine development that may impair fish populations including road development, fugitive dust, increased human access, etc. Taking these additional aspects into consideration, risks might be even more severe.

103. As mentioned, due to the availability of data, this report confines its analysis to the KSM project. In addition to KSM, several other mines are under consideration for this region, in watersheds with poor buffering capacity and little ability to assimilate metals or ameliorate their effects. Because environmental baseline data remain to be collected and modeled for other mines, their impacts to fish populations cannot be assessed. It is not unreasonable, however, to expect that harm to aquatic life will be similar downstream of other mines, at magnitudes relative to the size of each mine. The combined impacts of multiple mines would no doubt increase the likelihood of population-level harm in the Unuk, Stikine, and Taku Rivers.

104. The decision to proceed with mining should be made with the acknowledgement that large scale mine development will likely impact salmon and possibly eulachon and carries the potential of population collapse of some of these few remaining anadromous fish strongholds in North America.

DATED: November 13, 2018.



Sarah O'Neal

⁹⁸ Jenni et al. 2017

CITATIONS

Baldwin, D. H., C. P. Tatara, and N. L. Scholz. 2011. Copper-induced olfactory toxicity in salmon and steelhead: Extrapolation across species and rearing environments. *Aquatic Toxicology* **101**:295-297.

Beacham, T. D., and C. C. Wood. 1999. Application of microsatellite DNA variation to estimation of stock composition and escapement of Nass River sockeye salmon (*Oncorhynchus nerka*). *Canadian Journal of Fisheries and Aquatic Sciences* **56**:297-310.

Bocking, R. C., M. R. Link, B. Baxter, B. Nass, and L. Jantz. 2002. Meziadin Lake biological escapement goal and considerations for increasing yield of sockeye salmon (*Oncorhynchus nerka*). DFO Canada Research Document 2002/124. Canadian Science Advisory Secretariat, Kamloops, British Columbia. 56 pp.

Bowker, L. N., and D. M. Chambers. 2015. The risk, public liability, and economics of tailings storage facility failures. Center for Science in Public Participation, Bozeman, Montana. 56 pp.

Bury, N.R., D. Boyle, and C.A. Cooper. 2011. Iron. Pages 201-251 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish Physiology: and Toxicology of Essential Metals*, Volume 31A. Elsevier.

Canadian Environmental Assessment Agency. 2014. KSM (Kerr-Sulphur-Mitchell) Project Comprehensive Study Report. Ottawa, Ontario.

Chapman, G. A. 1978. Toxicities of cadmium, copper, and zinc to four juvenile stages of Chinook salmon and steelhead. *Transactions of the American Fisheries Society* **107**:841-847.

Craig, P. M., C. M. Wood, and G. B. McClelland. 2010. Water chemistry alters gene expression and physiological endpoints of chronic waterborne copper exposure in zebrafish, *Danio rerio*. *Environmental Science and Technology* **44**:2156-2162.

Dalzell, D. J. B., and N. A. A. Macfarlane. 1999. The toxicity of iron to brown trout and effects on the gills: A comparison of two grades of iron sulphate. *Journal of Fish Biology* **55**:301-315.

Delonay, A. J., E. E. Little, D. F. Woodward, W. G. Brumbaugh, A. M. Farag, and C. F. Rabeni. 1993. Sensitivity of early-life-stage golden trout to low pH and elevated aluminum. *Environmental Toxicology and Chemistry* **12**:1223-1232.

Dennis, I.F., and T.A. Clair. 2012. The distribution of dissolved aluminum in Atlantic salmon (*Salmo salar*) rivers of Atlantic Canada and its potential effect on aquatic populations. *Canadian Journal of Fisheries and Aquatic Sciences* **69**:1174-1183.

Department of Fisheries and Oceans Canada. 2016. 2016 Post Season Review: Salmon, North Coast Areas 1-6 & Central Coast Areas 7-10. 81 pp.

Eisler, R. 1986. Chromium hazards to fish, wildlife, and invertebrates: a synoptic review. Fish and Wildlife Service, US Department of the Interior.

Eisler, R. 1998. Copper hazards to fish, wildlife, and invertebrates: A synoptic review. DTIC Document.

Eisler, R. 2000. *Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals*, Three Volume Set. CRC Press.

Farag, A. M., D. F. Woodward, J. N. Goldstein, W. Brumbaugh, and J. S. Meyer. 1998. Concentrations of metals associated with mining waste in sediments, biofilm, benthic

macroinvertebrates, and fish from the Coeur d'Alene River Basin, Idaho. *Archives of Environmental Contamination and Toxicology* **34**:119-127.

Farag, A. M., D. Skaar, D. A. Nimick, E. MacConnell, and C. Hogstrand. 2003. Characterizing aquatic health using salmonid mortality, physiology, and biomass estimates in streams with elevated concentrations of arsenic, cadmium, copper, lead, and zinc in the Boulder River watershed, Montana. *Transactions of the American Fisheries Society* **132**:450-467.

Farag, A. M., T. May, G. D. Marty, M. Easton, D. D. Harper, E. E. Little, and L. Cleveland. 2006. The effect of chronic chromium exposure on the health of Chinook salmon (*Oncorhynchus tshawytscha*). *Aquatic Toxicology* **76**:246-257.

Franklin, N. M., C. N. Glover, J. A. Nicol, and C. M. Wood. 2005. Calcium/cadmium interactions at uptake surfaces in rainbow trout: Waterborne versus dietary routes of exposure. *Environmental Toxicology and Chemistry* **24**:2954-2964.

Franklin, N. M., J. L. Stauber, R. P. Lim, and P. Petocz. 2002. Toxicity of metal mixtures to a tropical freshwater alga (*Chlorella* sp.): The effect of interactions between copper, cadmium, and zinc on metal cell binding and uptake. *Environmental Toxicology and Chemistry* **21**:2412-2422.

Futer, P. and M. Nassichuk. 1983. Metals in eulachons from the Nass River and crabs from Alice Arm, B.C. Canadian Manuscript Report of Fisheries and Aquatic Sciences, No. 1699.

Gendusa, T. C., and T. L. Beitinger. 1992. External biomarkers to assess chromium toxicity in adult *Lepomis macrochirus*. *Bulletin of Environmental Contamination and Toxicology* **48**:237-242.

Gensemer, R. W., and R. C. Playle. 1999. The bioavailability and toxicity of Aluminum in aquatic environments. *Critical Reviews in Environmental Science and Technology* **29**:315-450.

Gray, N. F., and E. Delaney. 2010. Measuring community response of benthic macroinvertebrates in an erosional river impacted by acid mine drainage by use of a simple model. *Ecological Indicators* **10**:668-675.

Groot, C., and L. Margolis. 1991. *Pacific Salmon Life Histories*. University of British Columbia Press.

Grosell, M. 2011. Copper. Pages 53-133 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish Physiology: and Toxicology of Essential Metals*, Volume 31A. Elsevier.

Hilborn, R., T.P. Quinn, D.E. Schindler, and D.E. Rogers. 2003. Biocomplexity and fisheries sustainability. *Proceedings of the National Academy of Sciences* **100**(11): 6564-6568.

Hansen, J. A., J. C. A. Marr, J. Lipton, D. Cacela, and H. L. Bergman. 1999a. Differences in neurobehavioral responses of Chinook salmon (*Oncorhynchus tshawytscha*) and rainbow trout (*Oncorhynchus mykiss*) exposed to copper and cobalt: Behavioral avoidance. *Environmental Toxicology and Chemistry* **18**:1972-1978.

Hansen, J. A., J. D. Rose, R. A. Jenkins, K. G. Gerow, and H. L. Bergman. 1999b. Chinook salmon (*Oncorhynchus tshawytscha*) and rainbow trout (*Oncorhynchus mykiss*) exposed to copper: Neurophysiological and histological effects on the olfactory system. *Environmental Toxicology and Chemistry* **18**:1979-1991.

Hecht, S. A., D. H. Baldwin, C. A. Mebane, T. Hawkes, S. J. Gross, and N. L. Scholz. 2007. An overview of sensory effects on juvenile salmonids exposed to dissolved copper: applying a benchmark concentration approach to evaluate sublethal neurobehavioral toxicity. Technical white paper.

Hendrich, C., J. Weller, S. McPherson, and D. Bernard. 2008. Optimal production of Chinook salmon from the Unuk River. Alaska Department of Fish Game, Divisions of Sport Fish and Commercial Fisheries Fishery Manuscript No. 08-03. Anchorage, Alaska. 142 pp.

Hodson, P. V., U. Borgmann, and H. Shear. 1979. Toxicity of copper to aquatic biota. *Copper in the Environment* **2**:308-372.

Hogstrand, C. 2011. Zinc. Pages 135-200 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish Physiology: Homeostasis and Toxicology of Essential Metals*, Volume 31A. Elsevier.

Jaansson, A., and K. H. Olsén. 2010. Effects of copper on olfactory-mediated endocrine responses and reproductive behaviour in mature male brown trout *Salmo trutta* parr to conspecific females. *Journal of Fish Biology* **76**:800-817.

Janz, D. M. 2011. Selenium. Pages 327-374 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish Physiology: Homeostasis and Toxicology of Essential Metals*, Volume 31A. Elsevier.

Jenni, K.E., D.L. Naftz, and T.S. Presser. 2017. Conceptual modeling framework to support development of site-specific selenium criteria for Lake Koocanusa, Montana, USA, and British Columbia, Canada: U.S. Geological Survey Open-File Report 2017-1130, 14 p.

Johnson, A. W., M. Gutiérrez, D. Gouzie, and L. R. McAliley. 2016. State of remediation and metal toxicity in the Tri-State Mining District, USA. *Chemosphere* **144**:1132-1141.

Johnson, J., and B. Blossom. 2017. Catalog of waters important for spawning, rearing, or migration of anadromous fishes, Effective June 1, 2017. Alaska Department of Fish and Game, Special Publication No. 17-01. Anchorage, Alaska.

Klaprat, D. A., S. B. Brown, and T. J. Hara. 1988. The effect of low pH and aluminum on the olfactory organ of rainbow trout, *Salmo gairdneri*. *Environmental Biology of Fishes* **22**:69.

Knittel, M. D. 1981. Susceptibility of steelhead trout *Salmo gairdneri* Richardson to redmouth infection *Yersinia ruckeri* following exposure to copper. *Journal of Fish Diseases* **4**:33-40.

Kroglund, F., and B. Finstad. 2003. Low concentrations of inorganic monomeric aluminum impair physiological status and marine survival of Atlantic salmon. *Aquaculture* **222**:119-133.

Kuipers, J. R., A. Maest, K. A. MacHardy, and G. Lawson. 2006. Comparison of predicted and actual water quality at hardrock mines: the reliability of predictions in environmental impact statements. Kuipers and Associates, Buka Environmental, and Earthworks. Bozeman, Montana.

Lemly, A. D. 2004. Aquatic selenium pollution is a global environmental safety issue. *Ecotoxicology and Environmental Safety* **59**:44-56.

Lemly, D.A. 1985. Toxicology of selenium in a freshwater reservoir: Implications for environmental hazard evaluation and safety. *Ecotoxicology and Environmental Safety* **10**:314-338.

Levy, D. 2006. Nass River Salmon Fishery Report Card. Sierra Club of Canada, Ottawa, Ontario.

Lewis, B., W.S. Grant, R.E. Brenner, and T. Hamazaki. 2015. Changes in Size and Age of Chinook Salmon *Oncorhynchus tshawytscha* Returning to Alaska. *PLoS ONE* **10**:e0130184.

Lizardo-Daudt, H. M., and C. Kennedy. 2008. Effects of cadmium chloride on the development of rainbow trout *Oncorhynchus mykiss* early life stages. *Journal of Fish Biology* **73**:702-718.

Lorz, H., and B. McPherson. 1976. Effects of copper or zinc in fresh water on the adaptation to sea water and ATPase activity, and the effects of copper on migratory disposition of coho salmon (*Oncorhynchus kisutch*). *Journal of the Fisheries Research Board of Canada* **33**:2023-2030.

Marr, J. C. A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J. S. Meyer, and C. Hogstrand. 1996. Relationship between copper exposure duration, tissue copper concentration, and rainbow trout growth. *Aquatic Toxicology* **36**:17-30.

McDowell Group. 2016. Southeast Alaska Transboundary Watersheds: Economic Impact Analysis. Report prepared for SalmonState. Juneau, Alaska. 61 pp.

McGeer, J. C., S. Niyogi, and D. S. Smith. 2011. Cadmium. Pages 126-185 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish physiology: and toxicology of non-essential metals*. Elsevier.

McIntyre, J. K., D. H. Baldwin, D. A. Beauchamp, and N. L. Scholz. 2012. Low-level copper exposures increase visibility and vulnerability of juvenile coho salmon to cutthroat trout predators. *Ecological Applications* **22**:1460-1471.

McPhail, J. D. 2007. *The freshwater fishes of British Columbia*. University of Alberta Press.

McPherson, S. A., and J. K. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries Regional Information Report IJ97-06. Juneau, Alaska. 61 pp.

Mebane, C. A. 2010. Cadmium risks to freshwater life: Derivation and validation of low-effect criteria values using laboratory and field studies. USGS Scientific Investigations Report 2006-5245, Version 1.2. 132 pp.

Mebane, C. A., F. S. Dillon, and D. P. Hennessy. 2012. Acute toxicity of cadmium, lead, zinc, and their mixtures to stream-resident fish and invertebrates. *Environmental Toxicology and Chemistry* **31**:1334-1348.

Meyer, J. S., and W. J. Adams. 2010. Relationship between biotic ligand model-based water quality criteria and avoidance and olfactory responses to copper by fish. *Environmental Toxicology and Chemistry* **29**:2096-2103.

Mishra, A. K., and B. Mohanty. 2009. Chronic exposure to sublethal hexavalent chromium affects organ histopathology and serum cortisol profile of a teleost, *Channa punctatus* (Bloch). *Science of The Total Environment* **407**:5031-5038.

Mizuno, S., Y. Sasaki, N. Omoto, and K. Imada. 2004. Elimination of adhesiveness in the eggs of shishamo smelt *Spirinchus lanceolatus* using kaolin treatment to achieve high hatching rate in an environment with a high iron concentration. *Aquaculture* **242**:713-726.

Monette, M. Y., B. T. Björnsson, and S. D. McCormick. 2008. Effects of short-term acid and aluminum exposure on the parr-smolt transformation in Atlantic salmon (*Salmo salar*): Disruption of seawater tolerance and endocrine status. *General and Comparative Endocrinology* **158**:122-130.

Moody, M. F. 2008. Eulachon past and present. Master's Thesis. University of British Columbia. Vancouver, British Columbia. 307 pp.

Murphy, B. Seabridge Gold. 2017, July 5. Letter via email to E. Sexton, University of Montana.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, and S. T. Lindley. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC **35**:443.

Nisga'a Lisims Government. 2017 Nass River salmon stock assessment update - Monday, 4 September. Nisga'a Fisheries and Wildlife Department, New Aiyansh, British Columbia. 32 pp.

Payne, J. F., B. French, D. Hamoutene, P. Yeats, A. Rahimtula, D. Scruton, and C. Andrews. 2001. Are metal mining effluent regulations adequate: Identification of a novel bleached fish syndrome in association with iron-ore mining effluents in Labrador, Newfoundland. *Aquatic Toxicology* **52**:311-317.

Rand, G.M., 1995. Fundamentals of aquatic toxicology : effects, environmental fate, and risk assessment 2nd ed., Washington, D.C.: Taylor & Francis. 1124 pp.

Reid, S. D. 2011. Molybdenum and chromium. Pages 375-415 in C. M. Wood, A. P. Farrell, and C. J. Brauner, editors. *Fish Physiology: Homeostasis and Toxicology of Essential Metals*. Volume 31A. Elsevier.

Rescan Environmental Services Ltd. 2013. Application for an Environmental Assessment Certificate/Environmental Impact Statement for the KSM Project. Vancouver, British Columbia. <https://projects.eao.gov.bc.ca/p/ksm/docs?folder=44>

Reynolds, J.B. 1997. Ecology of overwintering fishes in Alaskan freshwaters. Pp 281-302 in A.M Milner, M.W. Milner, and M.W. Oswood (Eds.), *Freshwaters of Alaska: Ecological Syntheses*. Springer-Verlag, New York.

Ricard, A. C., C. Daniel, P. Anderson, and A. Hontela. 1998. Effects of subchronic exposure to cadmium chloride on endocrine and metabolic functions in rainbow trout *Oncorhynchus mykiss*. *Archives of Environmental Contamination and Toxicology* **34**:377-381.

Richards, P. Alaska Department of Fish and Game Fish Biologist. 2017, July 15. Email with S. O'Neal.

Riddell, D. J., J. M. Culp, and D. J. Baird. 2005. Sublethal effects of cadmium on prey choice and capture efficiency in juvenile brook trout (*Salvelinus fontinalis*). *Environmental Toxicology and Chemistry* **24**:1751-1758.

Rougier, F., D. Troutaud, A. Ndoye, and P. Deschaux. 1994. Non-specific immune response of zebrafish, *Brachydanio rerio* (Hamilton-Buchanan) following copper and zinc exposure. *Fish and Shellfish Immunology* **4**:115-127.

Sanchez-Dardon, J., I. Voccia, A. Hontela, S. Chilmonczyk, M. Dunier, H. Boermans, B. Blakley, and M. Fournier. 1999. Immunomodulation by heavy metals tested individually or in mixtures in rainbow trout (*Oncorhynchus mykiss*) exposed in vivo. *Environmental Toxicology and Chemistry* **18**:1492-1497.

Sandahl, J. F., D. H. Baldwin, J. J. Jenkins, and N. L. Scholz. 2007. A sensory system at the interface between urban stormwater runoff and salmon survival. *Environmental Science and Technology* **41**:2998-3004.

Santore, R. C., R. Mathew, P. R. Paquin, and D. DiToro. 2002. Application of the biotic ligand model to predicting zinc toxicity to rainbow trout, fathead minnow, and *Daphnia magna*. *Comparative Biochemistry and Physiology Part C: Toxicology and Pharmacology* **133**:271-285.

Scannell, P. W. 2009. Effects of copper on aquatic species: A review of the literature. Alaska Department of Fish and Game Technical Report No. 09-04. Anchorage, Alaska. 119 pp.

Schindler, D. E., R. Hilborn, B. Chasco, C. P. Boatright, T. P. Quinn, L. A. Rogers, and M. S. Webster. 2010. Population diversity and the portfolio effect in an exploited species. *Nature* **465**:609-612.

Schreck, C. B., and H. W. Lorz. 1978. Stress response of coho salmon (*Oncorhynchus kisutch*) elicited by cadmium and copper and potential use of cortisol as an indicator of stress. *Journal of the Fisheries Research Board of Canada* **35**:1124-1129.

Scott, G. R., K. A. Sloman, C. Rouleau, and C. M. Wood. 2003. Cadmium disrupts behavioural and physiological responses to alarm substance in juvenile rainbow trout (*Oncorhynchus mykiss*). *Journal of Experimental Biology* **206**:1779-1790.

Shaul, L., S. A. McPherson, E. Jones, and K. Crabtree. 2003. Stock status and escapement goals for coho salmon stocks in Southeast Alaska. *Alaska Department of Fish and Game Southeast Region Special Publication No. 03-02*. Douglas, Alaska. 48 pp.

Sigler, M. F., J. N. Womble, and J. J. Vollenweider. 2004. Availability to Steller sea lions (*Eumetopias jubatus*) of a seasonal prey resource: a prespawning aggregation of eulachon (*Thaleichthys pacificus*). *Canadian Journal of Fisheries and Aquatic Sciences* **61**:1475-1484.

Sloman, K. A., G. R. Scott, Z. Diao, C. Rouleau, C. M. Wood, and D. G. McDonald. 2003. Cadmium affects the social behaviour of rainbow trout, *Oncorhynchus mykiss*. *Aquatic Toxicology* **65**:171-185.

Stevens, D. G. 1977. Survival and immune response of coho salmon exposed to copper. Environmental Protection Agency, Office of Research and Development, Corvallis Environmental Research Laboratory, Western Fish Toxicology Station.

Suter II, G. W. 2007. Ecological Risk Assessment, 2nd Ed. CRC press. 643 pp.

Tierney, K. B., D. H. Baldwin, T. J. Hara, P. S. Ross, N. L. Scholz, and C. J. Kennedy. 2010. Olfactory toxicity in fishes. *Aquatic Toxicology* **19**:2298-2308.

Updegraff, K. F., and J. L. Sykora. 1976. Avoidance of lime-neutralized iron hydroxide solutions by coho salmon in the laboratory. *Environmental Science and Technology* **10**:51-54.

Urabe, J. 1991. Effect of food concentration on growth, reproduction and survivorship of *Bosmina longirostris* (Cladocera). *Freshwater Biology* **25**:1-8.

Wagner, G. F., and B. A. McKeown. 1982. Changes in plasma insulin and carbohydrate metabolism of zinc-stressed rainbow trout, *Salmo gairdneri*. *Canadian Journal of Zoology* **60**:2079-2084.

Waiwood, K. G., and F. W. H. Beamish. 1978a. The effect of copper, hardness and pH on the growth of rainbow trout, *Salmo gairdneri*. *Journal of Fish Biology* **13**:591-598.

Waiwood, K. G., and F. W. H. Beamish. 1978b. Effects of copper, pH and hardness on the critical swimming performance of rainbow trout (*Salmo gairdneri* Richardson). *Water Research* **12**:611-619.

Weller, J., and D. Evans. 2012a. Production of the Unuk River Chinook salmon through 2008 from the 1992-2005 broods. *Alaska Department of Fish and Game Divisions of Sport and Commercial Fisheries Fishery Data Series No. 12-04*. Anchorage, Alaska. 128 pp.

Weller, J., and D. Evans. 2012b. Production of Unuk River Chinook salmon through 2009 from the 1992-2006 broods. *Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries Fishery Data Series No. 12-85*. Anchorage, Alaska. 104 pp.

Wilson, R. W., and C. M. Wood. 1992. Swimming performance, whole body ions, and gill aluminum accumulation during acclimation to sublethal aluminium in juvenile rainbow trout (*Oncorhynchus mykiss*). *Fish Physiology and Biochemistry* **10**:149-159.

Wilson, R. W., H. L. Bergman, and C. M. Wood. 1994. Metabolic costs and physiological consequences of acclimation to aluminum in juvenile rainbow trout (*Oncorhynchus mykiss*) 2: Gill morphology, swimming performance, and aerobic scope. Canadian Journal of Fisheries and Aquatic Sciences **51**:536-544.

Wootton, R. J. 1990. Ecology of teleost fishes. Springer.

Zipper, C. E., P. F. Donovan, J. W. Jones, J. Li, J. E. Price, and R. E. Stewart. 2016. Spatial and temporal relationships among watershed mining, water quality, and freshwater mussel status in an eastern USA river. Science of The Total Environment **541**:603-615.

CURRICULUM VITAE
for
SARAH LOUISE O'NEAL
sarahlouiseoneal@gmail.com
127 17TH ST SW, OLYMPIA, WA 98501
(360) 918-4352

SUMMARY OF QUALIFICATIONS

- Knowledgeable in ecology, evolution and conservation biology particularly with respect to freshwater ecosystems and salmonids
- Skilled at communicating technical language to a broad range of stakeholders
- Excellent oral and written communication skills
- Ability to work independently and as a team member

EDUCATION

June, 1999, University of Washington, Seattle, WA
B.S. Ecology, Evolution and Conservation Biology GPA 3.91, Cumulative GPA 3.89

May, 2008, Flathead Lake Biological Station, University of Montana, Missoula and Polson, MT
Advisor: Dr. Jack A. Stanford
M.S. Limnology GPA 3.86

In progress, University of Washington, Seattle, WA
Advisor: Dr. Daniel Schindler
PhD student School of Aquatic and Fishery Sciences Current GPA: 3.66

GRANTS/AWARDS

- Graduated *magna cum laude*
- Annual Dean's List, four consecutive years
- University of Washington Undergraduate Scholar Award, three consecutive years
- Mary Gates Undergraduate Research Training Grant
- Phi Beta Kappa
- Charles Levitan Scholarship
- Jessie M. Bierman Scholarship
- EPA Science to Achieve Results (STAR) research fellowship
- American Fisheries Society Cultural Diversity Travel Award
- National Fish Habitat Partnership grant recipient

PROFESSIONAL AFFILIATIONS

American Fisheries Society, local and national chapters member
Association for the Sciences of Limnology and Oceanography
Ecological Society of America
National Lake Management Society
Society for Freshwater Science
Washington Mountaineers
Washington State Lakes Protection Association

ADDITIONAL SKILLS

Trained in wilderness first aid and CPR
Trained in swiftwater safety
Trained in mountaineering and mountain oriented first aid by The Mountaineers (Seattle, WA)
Trained in jet and prop motor boat operation and safety by U.S. Coast Guard and others
Trained in electrofishing and snorkel survey techniques by Washington Trout
Set and drift gillnet commercial fisherman
Conversational in Spanish
Proficient in all Microsoft programs
Proficient in R programming language

PROFESSIONAL EXPERIENCE

PRINCIPAL: September 2013 through present

Agua Dulce Freshwater Consulting, Missoula, Montana and Seattle, Washington
Ecological contracting for non-profit and aboriginal organizations including Trout Unlimited,
Susitna River Coalition, Bristol Bay Heritage Land Trust, Center for Science in Public
Participation, and others. Conduct technical reviews, interpret freshwater ecological information
(including fisheries information) to a wide variety of audiences, conduct public and legislative
outreach and education, design and execute monitoring studies.

FISHERIES BIOLOGIST: February 2013 through September 2013

US Geological Survey, Bozeman, Montana
Conducted field and desktop research to support a salmon reintroduction project above large
hydropower dams in the lower Columbia River basin in Washington State.

ASSOCIATE DIRECTOR: June 2010 through December 2012

Fisheries Research and Consulting, Anchorage, Alaska
Planned and led field studies to determine baseline salmonid habitat conditions in Alaska's
remote Bristol Bay watershed. Conducted data analysis and dissemination. Presented
information to Bristol Bay residents, sportsman's groups, media, and academic audiences
regarding potential risks to fisheries from copper-sulfide mining. Conducted extensive literature
reviews regarding natural resources in Bristol Bay, risk factors threatening the region, and related
general ecology in order to assist with federal decisions regarding permitting for large-scale hard
rock mining activities. Assisted with expert testimony in an environmental lawsuit. Successfully
prepared and submitted grant applications fact sheets, literature reviews, and other gray literature.

POPULATION BIOLOGIST: December 2008 through June 2010

State of the Salmon Program, Portland, Oregon
Coordinated and planned large international, interdisciplinary conferences regarding Pacific
salmon conservation. The work included collaborating with experts in salmon science,
management, policy, and conservation to coordinate program content, as well as cultivate
sponsorship relationships, manage volunteers, and attend to a vast array of details in preparation
for and execution of the events. Success of the events required careful budget management,
fundraising, media outreach, extraordinary organizational skills and attention to detail.
Additionally conducted research regarding salmon management with respect to harvest and
hatchery practices; and conducted data collection, analysis, and dissemination regarding threats
posed by a large proposed mining project in Southwest Alaska.

(Professional experience continued)

RESEARCH ASSISTANT: May 2008 through November 2008

Flathead Lake Biological Station, Polson, Montana

Assisting with a comparative study between the Elk and North Fork of the Flathead Rivers in southeastern British Columbia regarding the effect of open-pit coal mining on the freshwater ecology of the two neighboring watersheds with respect to the proposed initiation of mining activity in the Flathead system. Additionally assisting with data collection for the Salmonid Rivers Observatory Network (SaRON) project assessing the health of salmon populations and their freshwater habitat in rivers throughout the Pacific Rim.

GRADUATE RESEARCH ASSISTANT, Tierra del Fuego: October 2005 through May 2008

University of Montana, Missoula, Montana and Rio Grande, Argentina

Successfully launched a project regarding life history and sport fishing management of a large anadromous brown trout population in Argentine Tierra del Fuego. The project entailed coordinating data collection and collaboration amongst 24 fishing guides and several local field technicians, as well as government agencies, a local university, and fishing lodges and their clients. Local Ecological Knowledge was also collected, the compilation of which informed the analysis of historical fishing records and general population trends. Additionally involved data collection, analysis, and interpretation at all trophic levels within rivers and streams (including algae, macroinvertebrates, juvenile and adult fish), as well as habitat data (including chemistry, discharge, and substrate metrics). Data resulting from this effort produced population and mortality estimates of the sea trout population generated by mark-recapture and fish scale analysis, as well as an assessment of the general health of the juvenile population and their freshwater habitat. The brown trout life history analysis was the subject of my master's thesis.

GRADUATE RESEARCH ASSISTANT, SaRON: May 2005 through October 2005

University of Montana, Missoula, Montana

Conducted fisheries and freshwater ecology research in British Columbia, Canada, and southwestern Alaska as part of the SaRON project. Work was conducted with a wide variety of people, including university colleagues, First Nations and native employees, government agencies, and non profit organizations and involved collection of aquatic ecological data of physical, chemical, and biological parameters.

TEACHING ASSISTANT: June 2004 through May 2005

University of Montana, Missoula, Montana

Lab instructor for introductory biology course for majors covering topics ranging from cellular structure to molecular genetics. Lectured to lab sections, administered and graded exams, supervised students' lab work, evaluated term papers. Additionally instructed freshwater biology labs, leading field trips, supervising lab work including aquatic organism identification and quantification, organizing and presenting lectures.

FISHERIES TECHNICIAN (VOLUNTEER): February 2005 through May 2005

State of Montana Fish Wildlife and Parks Department, Missoula, Montana

Gill netting a large reservoir in a research and exclusion effort focused on Northern Pike in the former Milltown Reservoir. Field fish identification and morphometric measurements, PIT tagging, radio tagging, and subsequent radio tracking.

(Professional experience continued)

WATER QUALITY ANALYST (Lakes and Streams): February 2000 through May 2004

Washington State Department of Ecology, Olympia, Washington

Data collection, analysis, and interpretation for lakes and rivers water quality assessments, Total Maximum Daily Load studies (TMDL). Generated approved Quality Assurance Project Plans (documents detailing study plans and design). Supervised up to four staff in data collection efforts. Created maps using ArcView and ArcGIS. Worked with private landowners as well as government agencies to coordinate data collection efforts. Processed data using statistical analysis (largely in SYSTAT and Excel) and wrote reports pertinent to results of the data collected. Lakes reports evaluated general lake health by compiling chemical, physical, and biological data. A nutrient criterion was determined and justified for each lake assessed. Data compilation required coordination with state Fish and Wildlife officials on fish habitat issues, identification of phytoplankton and zooplankton, knowledge of statistics, quality assurance, and limnological principles.

WASHINGTON CONSERVATION CORPS CORPSMEMBER: October 1999 through February 2000

Washington State Department of Ecology, Olympia, Washington:

Project Lead for the Chehalis River Best Management Practices Evaluation project which included field sample collection, taking flow measurements and calculating discharge, determining several parameters onsite, data management and analysis, and technical writing. Field Technician and Data Manager for the Dungeness River TMDL which included extensive work in Ecology's Environmental Information Management database, exceptional organization, and supervision of field assistants. Other miscellaneous field work and data collection including ArcView experience.

AQUATIC BOTANIST: Summers 1998, 1999, and 2000

Washington State Department of Ecology, Olympia, Washington

Assessed plant communities in lakes throughout the state of Washington paying specific attention to both rare plants and noxious weeds. Required familiarity with aquatic plant species and macroalgae, frequent use of botanical keys, and maintenance of an herbarium. Also demanded proficiency in small and large boat operation and field first aid. Interacted frequently with property owners and lake users in order to convey the importance of both native and nonnative plants to the health of a lake. Contributed to, and led, studies regarding the effectiveness of herbicides on aquatic weeds which involved both field work as well as lab and computer work. Field and lab work required knowledge of sampling techniques and project design, while computer work required the use of a large database (using Access) in addition to statistical analysis. Supervised up to two employees during both general surveys as well as herbicide effectiveness studies. Additionally evaluated fish and wildlife habitat and trained colleagues in those evaluation techniques. Assisted in field work and data analysis for TMDL studies.

RESEARCH ASSISTANT: September 1998 – June 1999

U.S. Forest Service & University of Washington, Seattle & Leavenworth, Washington

Researched the role of fire in the ecology in the life history of two rare plant species endemic to the Wenatchee Mountains. Lab, greenhouse, and field components all required attention to detail and careful reporting.

(Professional experience continued)

TECHNICAL WRITER: Summers 1996 and 1997

Washington State Labor and Industries, Tumwater, Washington

Wrote and designed several technical manuals for the purpose of training new hires after observing and analyzing colleagues work activities. Required extensive coordination and interaction with those observed in order to ensure accuracy. Exercised judgment and skills to provide a both clear and attractive presentation. Additionally performed legal research.

PUBLICATIONS

Peer Reviewed

Woody, C.A., S. O'Neal, D. Rinella, D. Bogan, D. Merrigan, and M. Geist. 2014. Environmental baseline and mining in remote Alaska. *Alaska Park Science* 13(2): 49-53.

O'Neal, S. and R.M. Hughes. 2012. Fisheries and hard rock mining: AFS symposium synopsis. *Fisheries* 37(2): 54-55.

O'Neal, S. and J.A. Stanford. 2011. Partial migration in a robust brown trout (*Salmo trutta*) population in a Patagonian River. *Transactions of the American Fisheries Society*. 140: 625-635.

Ciancio, J.E., M.A. Pascual, F. Botto, M. Amaya, S. O'Neal, and O. Iribarne. 2008. Anadromy detection in sympatric anadromous and resident introduced salmonids in Patagonia. *Journal of Fish Biology* 72: 1708-1719.

Parsons, J.K., K.S. Hamel, S.L. O'Neal, A. Moore. 2004. The Impact of Endothall on the Aquatic Plant Community of Kress Lake, Washington. *Journal of Aquatic Plant Management* 42:109-114.

Other

O'Neal, S. 2018. Pebble Project Department of the Army Application for Permit POA-2017-271. Expert comments to US Army Corps of Engineers regarding Clean Water Act Section 404 permit application by Pebble Limited Partnership for Trout Unlimited, AK.

O'Neal, S. 2015. A review of the Tulequah Chief Ecological Risk Assessment. Expert comments to the Canadian federal government for Rivers Without Borders.

O'Neal, S. 2015. BC Mines and the Taku Watershed. Juneau Empire. October 6. Juneau, AK.

O'Neal, S. 2013. Comments on Chapter 15 of Kerr-Sulphurets-Mitchell (KSM) Project Environmental Assessment, Fish and Aquatic Habitat. Expert comments to British Columbia provincial government for Trout Unlimited, AK.

O'Neal, S. 2012. Review of EPA work on Pebble was sound. Anchorage Daily News guest editorial. August 29. Anchorage, AK.

O'Neal, S. 2011. A review of PLP Environmental Baseline Documents: Resident fish and juvenile salmon habitat, distribution and assemblage. Fisheries Research and Consulting. Anchorage, AK. 21 pp.

(Other publications continued)

O'Neal, S. 2011. A review of PLP Environmental Baseline Documents: Aquatic macroinvertebrates (Bristol Bay drainages). Fisheries Research and Consulting. Anchorage, AK. 13 pp.

O'Neal, S. and C.A. Woody. 2011. Canada's Fraser River: Reasons for sockeye salmon declines with a comparison to Bristol Bay. Fisheries Research and Consulting. Anchorage, AK. 27 pp.

Woody, C.A. and S.L. O'Neal. 2010. Fish surveys in headwater streams of the Nushagak and Kvichak River drainages in Bristol Bay, Alaska, 2008-2010. The Nature Conservancy. Anchorage, AK. 48 pp.

O'Neal, S., J.A. Stanford, and A.L. Liberoff. October 2007. Population Status and Ecology of Brown Trout; Rio Grande, Tierra del Fuego, Argentina. Flathead Lake Biological Station. University of Montana. Polson, MT.

O'Neal, S. and J.A. Stanford. October 2006. Population Status and Ecology of Brown Trout; Rio Grande, Tierra del Fuego, Argentina. Flathead Lake Biological Station. University of Montana. Polson, MT.

Caroll, J., S.L. O'Neal, and S. Golding. April 2006. Wenatchee River Basin Dissolved Oxygen, pH, and Phosphorus Total Maximum Daily Load Study. Washington State Department of Ecology, Environmental Assessment Program. Olympia, WA.

Carroll, J. and S. O'Neal. Data Summary: Wenatchee River Basin Dissolved oxygen, pH and Fecal Coliform Total Maximum Daily Load. Washington State Department of Ecology, Environmental Assessment Program. Olympia, WA.

Caroll, J. and S. O'Neal. December 2005. Wenatchee River Basin Fecal Coliform Bacteria Total Maximum Daily Load Study. Washington State Department of Ecology, Environmental Assessment Program. Olympia, WA.

Bilheimer, D., J. Carroll, S. O'Neal, G. Pelletier. August 2003. Quality Assurance Project Plan: Wenatchee River Temperature, Dissolved Oxygen, pH, and Fecal Coliform Total Maximum Daily Load Year 2 Technical Study. Washington State Department of Ecology, Environmental Assessment Program.

Bilheimer, D., J. Carroll, S. O'Neal, G. Pelletier. July 2002. Quality Assurance Project Plan: Wenatchee River Temperature, Dissolved Oxygen, pH, and Fecal Coliform Total Maximum Daily Load Year 1 Technical Study. Washington State Department of Ecology, Environmental Assessment Program.

Sargeant, D., S. O'Neal, W. Ehinger. April 2002. Chehalis Best Management Practices Evaluation Project, Final Report for Water Quality Sites. Washington State Department of Ecology, Environmental Assessment Program.

Parsons, J. and S. O'Neal. September 2001. Aquatic Plants Technical Assistance Program 2000 Activity Report. Washington State Department of Ecology, Environmental Assessment Program.

(Other publications continued)

O'Neal, S., D. Hallock, K. Smith. Water Quality Assessments of Selected Lakes within Washington State: 1999. July 2001. Washington State Department of Ecology, Environmental Assessment Program.

Smith, A.K., D. Hallock, S. O'Neal. December 2000. Water Quality Assessment of Selected Lakes within Washington State: 1998. Washington State Department of Ecology, Environmental Assessment Program

MEDIA

Lewis, R. 2015. Activists: Canada mine approvals threaten Alaska fishing communities. Aljazeera America. July 10.

DeMarban, A. 2014. Manager says increasingly expensive Susitna dam could help salmon. Alaska Dispatch News. December 18. Anchorage, AK.

Denning, A. 2014. Transboundary group wants a voice in BC mining process. KTOO Public Radio. November 14. Juneau, AK.

Dobyn, P. 2014. Building a dam in paradise: Salmon in balance on the Susitna River. Pacific Fishing Magazine. September 2014: 6-12.

Dobyn, P. 2014. Hot dam! Anchorage Press. July 17. Anchorage, AK.

American Fisheries Society. 2012. Spotlight on women in fisheries. *Fisheries* 37(3): 132-135.

Fiorucci, D. 2012. Fish biologist alleges huge discrepancy in Pebble salmon estimates. KTUU Channel 2 News. Septemeber 30. Anchorage, AK.

Lempinen, E.W. 2011. In fight over Alaskan mine, public interest turns to science, AAAS News and Notes. *Science* 334(6055): 469-473.

Kean, S. 2010. Fishing for gold in the last frontier state. *Science* 327: 263-265.

Dobyn, P. 2010. Fighting to save the best of the last in Alaska's Bristol Bay. *Trout Magazine* Spring 2010: 24-27.

Wiswell, G. 2010. Rio Irigoyen searuns at the far end of the world. *Wild on The Fly Issue* 14: <http://www.wildonthefly.com/content/news-features?article=2>.

Behnke, R. 2009. Old fish in new waters: Sorting out nature from nurture. *Trout Magazine* Winter 2009: 56-58.

Randolph, J. 2009. Tierra del Fuego beneath the wind and whitecaps: A game plan for sea run success. *Fly Fisherman* December 2009: 30-35.

Caranci, M. 2009. Rio Grande brown trout. *Fly Fisherman* December 2009: 33 (inset).

(Media continued)

O'Neal, S. 2008. Merwin: A world record brown trout? Field and Stream, November 2008. Invited letter to the editor.

PRESENTATIONS

Invited

O'Neal, S., M. Hoy, M. Geist, D. Young, C. Ostberg, T. Simmons, D. Menning, and J. Duda. May 2018. Documenting habitat for anadromous species: Exploring affordable methods for protecting Alaska's salmon streams. American Fisheries Society, Western Division. Anchorage, AK.

Williams, N., M. Dischner, S. O'Neal, and A. Williams. May 2018. Safeguarding Bristol Bay. American Fisheries Society, Western Division. Anchorage, AK.

O'Neal, S., D. Young, C. Ostberg, J. Duda, M. Hoy, and M. Geist. March 2017. Documenting habitat for anadromous species: Exploring affordable methods for protecting Alaska's salmon streams. American Fisheries Society, Alaska Chapter. Fairbanks, AK.

O'Neal, S. March 2015. Sculpin Matter? Southwest Alaska Interagency Meeting (SWIM). Dillingham, AK.

O'Neal, S. November 2014. Potential impacts of Susitna Dam to salmon. Pacific Marine Expo. Seattle, WA.

O'Neal, S. April 2013. Global conservation of salmon and trout. Invited keynote. University of Montana Western Research Symposium. Dillon, MT.

O'Neal, S. and C.A. Woody. March 2012. Fish density and distribution in headwater streams in Bristol Bay, Alaska. Western Alaska Interdisciplinary Science Conference. Dillingham, AK.

Contributed

O'Neal, S. October 2014. Costs and benefits of large hydropower mitigation. Joint annual meeting of the Alaska chapters of the American Water Resources Association and the American Fisheries Society. Juneau, AK.

Woody, C.A. and S. O'Neal (presenter). October 2014. Coho salmon biodiversity, distribution, and density in a proposed mining area, Bristol Bay, Alaska. Joint annual meeting of the Alaska chapters of the American Water Resources Association and the American Fisheries Society. Juneau, AK.

O'Neal, S., C.A. Woody and K. Zamzow. February 2013. Freshwater baseline inventory and monitoring in headwater streams of a proposed hard rock mining district in Bristol Bay, Alaska. Montana Chapter of the American Fisheries Society Annual Meeting. Fairmont Hot Springs, MT.

(Contributed presentations continued)

Woody, C.A., S. O'Neal (presenter), and D. Bogan. November 2011. Freshwater baseline inventory and monitoring in Nushagak and Kvichak headwater streams. American Fisheries Society Alaska Chapter. Girdwood, AK.

O'Neal, S.L. (presenter and symposium organizer) and K. Zamzow. September 2011. Fish presence and water quality in a proposed copper mining district, Alaska. American Fisheries Society (national chapter, Fisheries and Hardrock Mining Symposium). Seattle, WA.

Woody, C.A., S. O'Neal (presenter), and D. Bogan. September 2011. Freshwater baseline inventory and monitoring in Nushagak and Kvichak headwater streams. American Association for the Advancement of Science Arctic Science Conference. Dillingham, AK.

O'Neal, S. and C.A. Woody. September 2010. Proposed copper-sulfide mining in Bristol Bay: identified risks to fisheries. Wild Trout Symposium X. West Yellowstone, MT.

O'Neal, S. and J. Stanford. June 2008. Life history variation of introduced brown trout in a Patagonian River. Oral presentation. North American Benthological Society Annual Meeting, Salt Lake City, UT.

O'Neal, S. May 2008. Lessons to learn from all out invasion: Life history of brown trout in a Patagonian river. Master's thesis defense. Presented to the Department of Biological Sciences and the Flathead Lake Biological Station, University of Montana, Missoula, MT.

O'Neal, S. October 2006. Brown trout invasion of the Rio Grande, Tierra del Fuego: The role of life history. Oral presentation. October 18, 2006. Presented to the Department of Biological Sciences, University of Montana, Missoula, MT.

Outreach

O'Neal, S. April 2018. Testimony to US Army Corps of Engineers regarding risks of mine development to Bristol Bay fisheries. Nondalton, AK.

O'Neal, S. March 2018. Defining fish habitat in Alaska's waters. Alaska State Legislature informational presentation. Juneau, AK.

O'Neal, S. March 2018. Defining fish habitat in Alaska's waters. United Fishermen of Alaska informational presentation. Juneau, AK.

O'Neal, S. April 2014. Presentations to Alaska State legislators regarding salmon ecology and hydropower development. Juneau, AK.

O'Neal, S. October 2014. Risks of hard rock mining to salmon, BC-Alaska transboundary rivers. Public presentations in communities throughout southeast Alaska: Juneau, Ketchikan, Wrangell, Petersburg, and Sitka.

O'Neal, S. March 2011. Presentation to executive members of EPA Region 10 staff regarding existing natural resources of Bristol Bay. Seattle, WA.

(Outreach continued)

O'Neal, S. January 2011. Presentation to executive members of the EPA Office of Wetlands, Oceans, and Watersheds regarding fish, wildlife, municipal water, and recreational resources. Washington, D.C.

O'Neal, S. August 2010. Community technical outreach regarding fisheries and freshwater resources to the communities of Koliganek and New Stuyahok, AK.

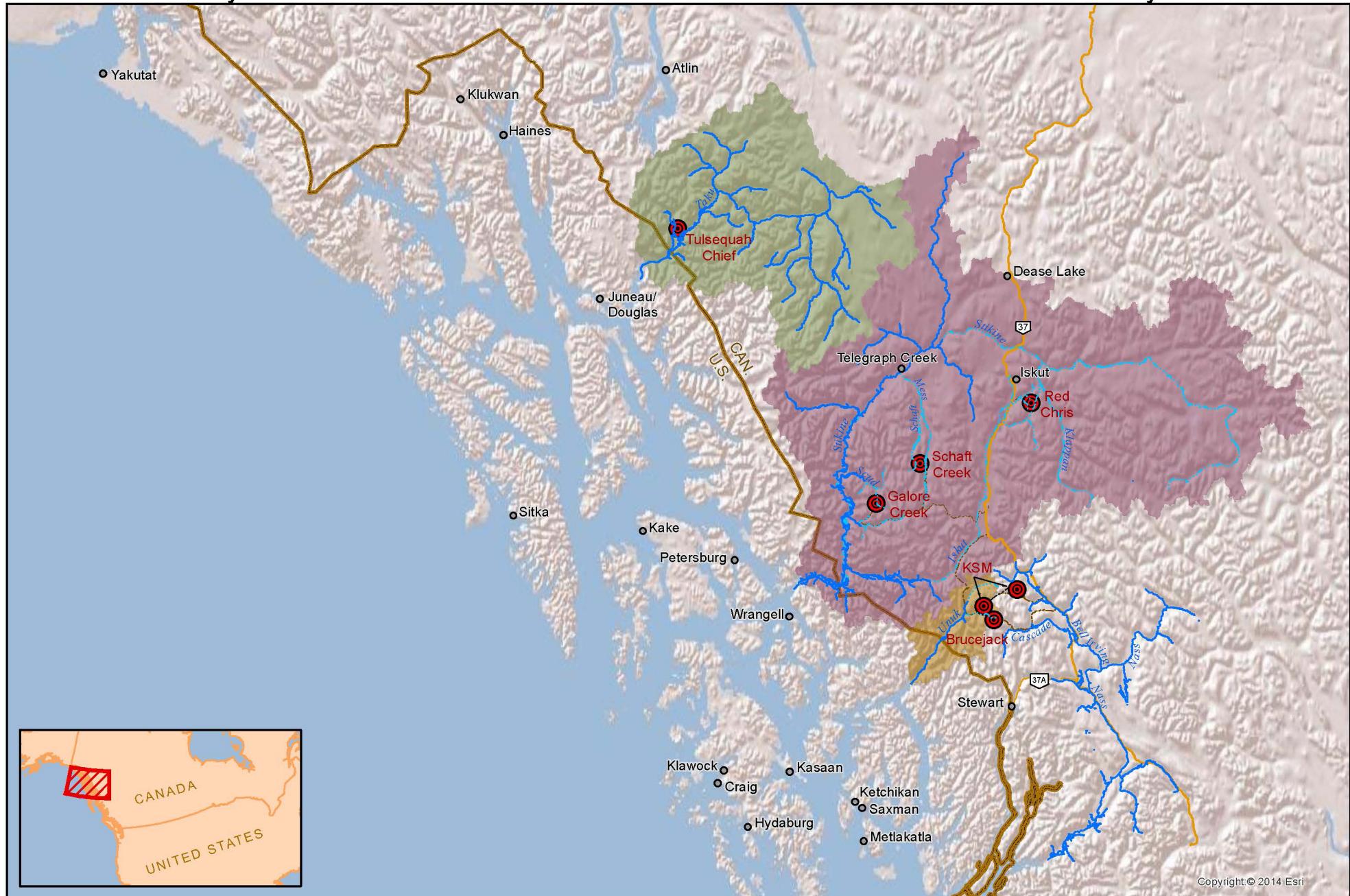
O'Neal, S. December 2009. Technical testimony to the Alaska Board of Fisheries regarding third party scientific review for large-scale mine permitting. Anchorage, AK.

Woody, C.A. and S. O'Neal (presenter). November 2008. Bristol Bay and Pebble Mine: Identified Risks. Presentations in the communities of Togiak and Dillingham, AK.

APPENDIX 4

MAP OF TRANSBOUNDARY WATERSHEDS AND SOUTHEAST ALASKA
NATIVE COMMUNITIES THREATENED BY B.C. MINES (OCT. 19, 2018)

Transboundary Watersheds and Southeast Alaska Native Communities Threatened by B.C. Mines



— Affected Anadromous River Segments
— Affected Other River Segments

Stikine Watershed
Taku Watershed
Unuk Watershed

— Mine Access Road
- - - Mitchell Treaty Tunnel
● Mine

 EARTHJUSTICE

Oct. 19, 2018

Data Sources: ESRI, HydroSHEDS,
AK GFD, BC Fisheries,
Natural Resources Canada